PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-107505

(43)Date of publication of application : 30.04.1993

(51)Int.CI. G02B 27/28

G02B 5/30

G02F 1/13

G02F 1/1335

G02F 1/1347

G03B 33/12

H04N 5/74

(21)Application number : 04-087211

(22)Date of filing : 08.04.1992

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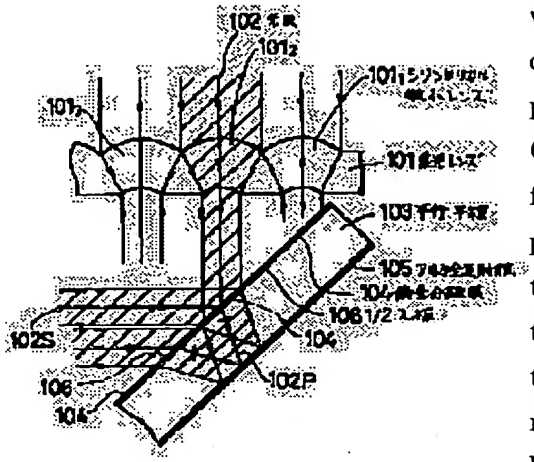
(30)Priority

Priority number : 03103317 Priority date : 09.04.1991 Priority country : JP

(54) PLANAR POLARIZING ELEMENT, POLARIZED LIGHT CONVERSION UNIT WITH SAME ELEMENT, AND IMAGE PROJECTION DEVICE WITH SAME UNIT



(57)Abstract:

PURPOSE: To provide a polarizing element which efficiently uses incident light and constitutes the low-cost, small-sized image projection device.

CONSTITUTION: A polarized light splitting film 104 which splits light made incident on a parallel flat plate 103 from one surface side or the other surface side into reflected light and transmitted light is provided on one surface of the transparent parallel flat plate 103; and the reflected light or transmitted light is reflected by the reflecting surface provided on the other surface of the transparent parallel flat plate 103 and directed to an optional path nearly parallel to the optical path of the other light beam, and the plane of polarization of at least one of the reflected light and transmitted light is varied to match the planes of polarization of both the light beams with each other.

LEGAL STATUS

[Date of request for examination] 13.04.1998

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 2989710

[Date of registration] 08.10.1999

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] One field of a transparence parallel plate is equipped with the polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which carries out incidence to this parallel plate from the one [this] field or field side of another side. The tabular polarizing element characterized by reflecting in the reflector which prepared one light of this reflected light and the transmitted light in the field of said another side of this transparence parallel plate, changing the plane of polarization of one [at least] light of this reflected light and the transmitted light towards an optical path almost parallel to the optical path of the light of another side, and making the plane of polarization of both light in agreement.
[Claim 2] The tabular polarizing element of claim 1 characterized by forming 1 / 2lambda film in the predetermined part of one [said] field of said transparence parallel plate in order to change the plane of polarization of one light of said reflected light and the transmitted light and to make it in agreement with the plane of polarization of the light of another side.
[Claim 3] The tabular polarizing element of claim 1 characterized by arranging 1 / 2lambda plate near one [said] field of said transparence parallel plate in order to change the plane of polarization of one light of said reflected light and the transmitted light and to make it in agreement with the plane of polarization of the light of another side.
[Claim 4] The tabular polarizing element of claim 1 characterized by forming 1 / 4lambda film in the field of said one side of said transparence parallel plate, or another side in order to change the plane of polarization of one light of said reflected light and the transmitted light and to make it in agreement with the plane of polarization of the light of another side.
[Claim 5] It has the illumination system which supplies grid-like unpolarized light light, and the polarizing element installed to the optical axis of this illumination system so it might make this unpolarized light light change into an almost dense polarization light. It has the transparence parallel plate with which this polarizing element equipped one field with the polarization demarcation membrane. Reflect in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. The polarization conversion unit characterized by changing the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement.
[Claim 6] The polarization conversion unit of claim 5 characterized by equipping said illumination system with the light source section which put many light emitting devices in order, and a fly eye lens.
[Claim 7] The polarization conversion unit of claim 5 characterized by equipping said illumination system with the fly eye lens which divides the light from the light source into plurality.
[Claim 8] The polarization conversion unit of claim 5 characterized by the thing of the field of another side of said transparence parallel plate for which the reflective film is mostly formed in the whole surface.
[Claim 9] The polarization conversion unit of claim 5 characterized by the thing of one field of said transparence parallel plate for which said polarization demarcation membrane is mostly formed in the whole surface.
[Claim 10] Said polarizing element receives said grid-like unpolarized light light in respect of one side of said transparence parallel plate. Said grid-like transmitted light is turned to the field of another side of said transparence parallel plate from said polarization demarcation membrane. The polarization conversion unit of

claim 9 characterized by forming 1 / 2lambda plate in the shape of a grid in order to change the plane of polarization of said grid-like transmitted light reflected in respect of another side of said transparence parallel plate on said polarization demarcation membrane and to make it in agreement with the plane of polarization of said grid-like reflected light.
[Claim 11] The polarization conversion unit of claim 10 characterized by the thing of the field of another side of said transparence parallel plate for which the reflective film is mostly formed in the whole surface.
[Claim 12] Said polarizing element receives said grid-like unpolarized light light in respect of one side of said transparence parallel plate. Said grid-like transmitted light is turned to the field of another side of said transparence parallel plate from said polarization demarcation membrane. said grid-like transmitted light -- said transparence -- in agreement with the plane of polarization of said grid-like reflected light, while making it reflect in respect of parallel monotonous another side -- it should make -- said transparence -- the polarization conversion unit of claim 5 characterized by the thing of the field of parallel monotonous another side for which 1 / 4lambda plate, and the reflective film are mostly formed in the whole surface.
[Claim 13] Said polarizing element receives said grid-like unpolarized light light in respect of one side of said transparence parallel plate. Form said polarization demarcation membrane in the shape of a grid, and said grid-like transmitted light is turned to the field of another side of said transparence parallel plate from said polarization demarcation membrane. said transparence -- parallel -- monotonous -- on the other hand, a field -- said transparence -- the polarization conversion unit of claim 5 characterized by forming 1 / 2lambda film in the shape of a grid by turns [said / polarization demarcation membrane and by turns] in order to make in agreement with the plane of polarization of said grid-like transmitted light the plane of polarization of said grid-like reflected light reflected in respect of parallel monotonous another side.
[Claim 14] The light source which emits unpolarized light light, and the illumination-light study system which changes the unpolarized light light from this light source into polarization light, In equipment equipped with the image generator made to generate an image by modulating this polarization light according to a video signal, and the projection optics which projects this image The conversion system from which said illumination-light study system changes said unpolarized light light into an optical grid-like pattern, It has the polarizing element installed to the optical axis of this conversion system so it might make this grid-like light pattern change into polarization light almost densely. It has the transparence parallel plate with which this polarizing element equipped one field with the polarization demarcation membrane. Reflect in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. Image projection equipment characterized by changing the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement.
[Claim 15] The light source which emits unpolarized light light, and the illumination-light study system which changes the unpolarized light light from this light source into polarization light, In equipment equipped with the image generator made to generate an image by modulating this polarization light according to a video signal, and the projection optics which projects this image Said image generator has three generators made to generate the image of each color of RGB. It has the color-separation system to which said illumination-light study system decomposes said unpolarized light light into the unpolarized light light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this grid-like light pattern which change unpolarized light light into an optical grid-like pattern at each optical path of the unpolarized light light of three colors of this RGB change into polarization light almost densely. Each of this polarizing element has the transparence parallel plate which prepared the polarization demarcation membrane in one field. Reflect in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. Image projection equipment characterized by changing the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement.
[Claim 16] The light source which emits unpolarized light light, and the illumination-light study system which changes the unpolarized light light from this light source into polarization light, In equipment equipped with the image generator made to generate an image by modulating this polarization light according to a video signal,

and the projection optics which projects this image Said image generator has three generators made to generate the image of each color of RGB. It has the color-separation system to which said illumination-light study system decomposes said unpolarized light light into the unpolarized light light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this grid-like light pattern which change unpolarized light light into an optical grid-like pattern at each of the common optical path of the unpolarized light light of two colors in this RGB, and the optical path of the unpolarized light light of other Isshiki change into polarization light almost densely. Each of this polarizing element has the transparence parallel plate which equipped one field with the polarization demarcation membrane. Reflect in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. Image projection equipment characterized by changing the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement.

[Claim 17] The polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which carries out incidence to this parallel plate from the field side of another side of this parallel plate is prepared in one field of a transparence parallel plate all over abbreviation. It turns to an parallel optical path. this reflected light -- this -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- The tabular polarizing element characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by establishing a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.

[Claim 18] The tabular polarizing element of claim 17 characterized by these plane-of-polarization rotation means being 1 / 4lambda film which were prepared in one field of these parallel plates.

[Claim 19] The tabular polarizing element of claim 17 to which this plane-of-polarization rotation means is characterized by being an optically active substance.

[Claim 20] The tabular polarizing element of claim 17 characterized by having constituted this parallel plate from an optically active substance, and considering as said plane-of-polarization rotation means.

[Claim 21] It has the illumination system which supplies the stripe-like flux of light, and the polarizing element installed to the optical axis of this illumination system so it might make this flux of light change into an almost dense polarization light. This polarizing element prepares the polarization demarcation membrane which divides the incident light which penetrates and carries out incidence of the field of another side of a this transparence parallel-from illumination system plate at the reflected light and the transmitted light at one field of a transparence parallel plate all over abbreviation. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- The tabular polarizing element unit characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.

[Claim 22] Claim 5 or 21 polarization conversion units which are characterized by equipping said illumination system with the light source section which put many light emitting devices in order, and a cylindrical lens.

[Claim 23] Claim 5 or 21 polarization conversion units which are characterized by equipping said illumination system with the cylindrical lens which divides the light from the light source into plurality.

[Claim 24] In equipment equipped with the light source, the illumination-light study system which changes the flux of light from this light source into polarization light, the image generator made to generate an image by modulating this polarization light according to a video signal, and the projection optics which projects this image The conversion system from which said illumination-light study system changes the flux of light from said light source in the shape of a stripe, It has the polarizing element installed to the optical axis of this conversion system so it might make this grid-like light pattern change into polarization light almost densely. This polarizing element prepares the polarization demarcation membrane which divides the incident light which penetrates and carries out incidence of the field of another side of a this transparence parallel-from illumination

system plate at the reflected light and the transmitted light at one field of a transparence parallel plate all over abbreviation. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- Image projection equipment characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.

[Claim 25] In equipment equipped with the light source, the illumination-light study system which changes the flux of light from this light source into polarization light, the image generator made to generate an image by modulating this polarization light according to a video signal, and the projection optics which projects this image Said image generator has three generators made to generate the image of each color of RGB. It has the color-separation system from which said illumination-light study system separates said flux of light into the flux of light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this stripe-like light pattern which change the flux of light into an optical stripe-like pattern at each optical path of the flux of light of three colors of this RGB change into polarization light almost densely. Each of this polarizing element prepares the polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which penetrates and carries out incidence of the field of another side of this transparence parallel plate from an illumination system all over abbreviation in one field of a transparence parallel plate. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- Image projection equipment characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.

[Claim 26] In equipment equipped with the light source, the illumination-light study system which changes the flux of light from this light source into polarization light, the image generator made to generate an image by modulating this polarization light according to a video signal, and the projection optics which projects this image Said image generator has three generators made to generate the image of each color of RGB. It has the color-separation system from which said illumination-light study system separates said flux of light into the flux of light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this stripe-like light pattern which change the flux of light into an optical stripe-like pattern at each of the common optical path of the flux of light of two colors in this RGB, and the optical path of the flux of light of other Isshiki change into polarization light almost densely. Each of this polarizing element prepares the polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which penetrates and carries out incidence of the field of another side of this transparence parallel plate from an illumination system all over abbreviation in one field of a transparence parallel plate. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- Image projection equipment characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.

[Claim 27] Said polarizing element receives said grid-like unpolarized light light in respect of said another side of said transparence parallel plate. It separates into said grid-like transmitted light and said grid-like reflected light by the polarization demarcation membrane of one [said] field. Said grid-like reflected light is turned to the field of said another side of said transparence parallel plate. The polarization conversion unit according to claim 9 characterized by forming 1 / 2lambda plate in the shape of a grid in order to change the plane of polarization of said grid-like reflected light reflected in respect of another side of said transparence parallel plate on one [said] field and to make it in agreement with the plane of polarization of said grid-like transmitted light.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the polarizing element which arranges the polarization direction and carries out outgoing radiation of the light with various polarization direction components by which incidence was carried out.
[0002]
[Description of the Prior Art] The image projection equipment of a configuration as conventionally shown in drawing 17 is known.
[0003] It is the incident light study system projected on the screen which divides into R, G, and B the flux of light generated in the light source 1550 with dichroic mirrors 1551 and 1552, also uses a total reflection mirror 1553, leads to the liquid crystal light valves 1554, 1555, and 1556, performs an optical path by the total reflection mirror 1557, compounds three images, R, G, and B, with bending and dichroic mirrors 1558 and 1559 further, and is not illustrated with a projector lens 1560.
[0004] In such image projection equipment, if the liquid crystal light valves 1554, 1555, and 1556 are made into the gestalt which sandwiched two polarizing plates which are polarizing elements about a liquid crystal plate and incidence of the natural light with various the polarization directions is carried out to the polarizing plate by the side of incidence, the polarization of those other than the one polarization direction will be absorbed with the polarizing plate by the side of this incidence, and the configuration by which incidence only of the light of one polarization component is carried out to a liquid crystal plate will be taken.
[0005] The configuration which abandons the polarizing plate by the side of incidence, instead arranges the polarization direction with an one direction using prism and the beam splitter which is a polarizing element, and carries out incidence to a liquid crystal plate on the other hand in what was indicated by JP,61-90584,A is taken.

[0006]
[Problem(s) to be Solved by the Invention] In what was shown in drawing 17 , it is a polarizing plate by the side of incidence, and since light other than the polarization direction of this polarizing plate will be absorbed, there is a trouble that a projection screen becomes dark, further, the temperature of a liquid crystal plate rises by the absorbed light, and there is a trouble of causing degradation of a liquid crystal plate.
[0007] On the other hand, since a polarization beam splitter and prism were used in what was indicated by JP,61-90584,A, equipment is enlarged and also there was a trouble that time and effort and cost started polish of prism. What uses the glass block like prism becomes heavy too much, and porter BIRIDI as image projection equipment worsens.
[0008] this invention is made in view of the trouble which the technique has had since [which was mentioned above] each **, incident light can be used efficiently, and it aims at realizing the polarizing element which can realize low cost and small image projection equipment.
[0009]
[Means for Solving the Problem] The tabular polarizing element of this invention equips one field of a transparence parallel plate with the polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which carries out incidence to this parallel plate from the one [this] field or field side of another side. It reflects in the reflector which prepared one light of this reflected light and the transmitted light in the field of said another side of this transparence parallel plate, and towards an optical

path almost parallel to the optical path of the light of another side, the plane of polarization of one [at least] light of this reflected light and the transmitted light is changed, and the plane of polarization of both light is made in agreement.
[0010] Moreover, the illumination system to which the polarization conversion unit of this invention supplies grid-like unpolarized light light, It has the polarizing element installed to the optical axis of this illumination system so it might make this unpolarized light light change into an almost dense polarization light. It has the transparence parallel plate with which this polarizing element equipped one field with the polarization demarcation membrane. It reflects in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and towards an optical path almost parallel to the optical path of the light of another side, the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light is changed, and the plane of polarization of both light is made in agreement.
[0011] Moreover, the illumination-light study system from which the image projection equipment of this invention changes into polarization light the unpolarized light light from the light source which emits unpolarized light light, and this light source, In equipment equipped with the image generator made to generate an image by modulating this polarization light according to a video signal, and the projection optics which projects this image The conversion system from which said illumination-light study system changes said unpolarized light light into an optical grid-like pattern, It has the polarizing element installed to the optical axis of this conversion system so it might make this grid-like light pattern change into polarization light almost densely. It has the transparence parallel plate with which this polarizing element equipped one field with the polarization demarcation membrane. It reflects in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and towards an optical path almost parallel to the optical path of the light of another side, the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light is changed, and the plane of polarization of both light is made in agreement.
[0012]
[Function] Since it is made to change so that one of both sides' plane of polarization of the light reflected in an optical path almost parallel to the light reflected by the polarization demarcation membrane prepared in the field and the reflected light penetrate a polarization demarcation membrane and according to the above-mentioned polarization demarcation membrane in the field of parallel monotonous another side monotonously [while] in parallel may correspond, the plane of polarization and the travelling direction of the light reflected by the polarization demarcation membrane and the light which penetrated this polarization demarcation membrane become the equal thing.
[0013]
[Example] Drawing 1 is drawing showing the configuration of the 1st example of the polarizing element of this invention.
[0014] This example is resin mold goods which consist of cylindrical microlenses 1011, 1012, and 1013, and consists of a condenser lens 101 which is the illumination system which carries out outgoing radiation of the incident light as a grid-like unpolarized light light, and an parallel plate 103 by the transparent optical material prepared at the include angle of 45 degrees to the optical axis of this condenser lens 101. It has power negative in the field by the side of outgoing radiation for power forward [each / of these cylindrical microlenses 1011, 1012, and 1013] in the field by the side of incidence, negative power has power twice the magnitude of forward, and the incident light which is parallel light has the function of the afocal converter by which outgoing radiation is carried out by becoming the parallel light of the width of face of 1/the 2.
[0015] the width of face of the flux of light from which the pair of 1 / 2lambda plate 106 of the shape of the polarization demarcation membrane 104 which consists of multilayers, and film (1/2-wave film) is the pitch of each cylindrical microlenses 1011-1013 seen from the direction 45 degrees, and each width of face was condensed by each cylindrical microlenses 1011-1013 by the field by the side of the condenser lens 101 of the parallel plate 103, and abbreviation -- it is prepared in the shape of SUTORAIBU so that it may become the same width of face. The aluminum total reflection film 105 which performed high reflective processing to the field by the side of the anti-condenser lens 101 of the parallel plate 103 is formed in the whole surface.
[0016] If the flux of light 102 which carries out incidence to a condenser lens 101 is made into abbreviation

parallel light, this flux of light 102 will be compressed into the parallel light of the shape of a grid of one half of width of face by each cylindrical microlenses 1011-1013 of a condenser lens 101, and will be separated as follows by the polarization demarcation membrane 104 prepared in the field by the side of the condenser lens 101 of the parallel plate 103.

[0017] S polarization 102S are reflected in the direction which intersects perpendicularly to incident light, and P polarization 102P penetrate. It is reflected by the aluminum total reflection film 105 prepared in the field by the side of the anti-incidence of the parallel plate 103, and by passing along 1 / 2lambda plate 106 after this, the polarization direction rotates 90 degrees, and P polarization 102P transmitted become S polarization, and carry out outgoing radiation. Thus, the natural light by which incidence was carried out is arranged with S polarization. In addition, without forming the aluminum total reflection film 105, the field by the side of the anti-incidence of the parallel plate 103 may be set as a total reflection side, and P polarization may be reflected in respect of this.

[0018] Drawing 2 is drawing showing the configuration of the image projection equipment with which the polarizing element constituted as mentioned above was incorporated.

[0019] Outgoing radiation of the parallel flux of light with various the polarization directions which the light source 250 generates is changed and carried out only to S polarization by the polarizing element shown in drawing 1 .

[0020] Each of the dichroic mirror 251,252,258,259 in this example, a total reflection mirror 253,257, the liquid crystal light valve 254,255,256, and a projector lens 260 is constituted like the dichroic mirrors 1551, 1552, 1558, and 1559 shown in drawing 17 , total reflection mirrors 1553 and 1557, the liquid crystal light valves 1554, 1555, and 1556, and a projector lens 1560.

[0021] Each of the liquid crystal light valve 254,255,256 generates an image by modulating two or more liquid crystal devices built in according to the video signal inputted from the image generator (un-illustrating) which consists of three generators made to generate the image of each color of RGB. Each of a dichroic mirror 251,252,258,259 constitutes the color-separation system which decomposes into the unpolarized light light of three colors of RGB the illumination light changed only into S polarization by the polarizing element shown in drawing 1 .

[0022] Since the quantity of light loss in each liquid crystal light valve 254,255,256 is lost, a projection image can be made bright, and it stops also producing generating of heat by the absorption of light by considering as the above-mentioned configuration. In this case, it becomes unnecessary to prepare the polarizing plate by the side of the incidence of a liquid crystal light valve, and you may constitute in this way.

[0023] Here, since it can be made the form where P polarization will carry out incidence of the plane of incidence of a polarizing element to each dichroic mirror if it is made to become a field perpendicular to space and the light source 250 is arranged in the direction perpendicular to space, color-separation-composition can be performed efficiently.

[0024] Drawing 3 is drawing showing the configuration of the 2nd example of this invention.

[0025] This example formed the polarization demarcation membrane 304 which consists of multilayers in the whole surface, and has prepared it in the field by the side of the condenser lens of the parallel plate 103 formed at the include angle of 45 degrees to the optical axis of a condenser lens 101 by the width of face of the flux of light and the width of face of abbreviation identitas which are the pitch of the abbreviation cylindrical microlenses 1011-1013 which looked at film-like 1 / 2lambda plate 306 from the direction 45 degrees on this polarization demarcation membrane, and were condensed by each cylindrical microlens. Since other configurations are the same as that of the 1st example shown in drawing 1 , the same number is attached and explanation is omitted.

[0026] By making it the above configurations, there is no need of masking when vapor-depositing a polarization demarcation membrane, and it can simplify a work process further.

[0027] Drawing 4 is drawing showing the configuration of the 3rd example of this invention.

[0028] In the 2nd example, this example joins this parallel plate 409 for maintenance to the parallel plate 103 through the polarization demarcation membrane 304, after forming 1 / 2lambda plate 406 of the shape of film currently directly formed on the polarization demarcation membrane 304 on the parallel plate 409 for maintenance. Moreover, the aluminum total reflection film 305 prepared all over the field by the side of the anti-condenser lens 101 It sees from a direction 45 degrees. In the pitch of the abbreviation cylindrical

microlenses 1011-1013 And the stray light shall not reflect each width of face in the direction of outgoing radiation of normal light as aluminum total reflection film 405 prepared by the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens. Furthermore, the wrap absorption coating 411 is formed for the whole surface by the side of the anti-condenser lens 101 of the parallel plate 103, and the effectiveness of a stray light cut is obtained. Moreover, it may form so that a mutual phase may reverse 1 / 2lambda plate 406 in the shape of a grid on the parallel plate 103 and may reverse the polarization demarcation membrane 304 on the plate 409 for maintenance in the shape of a grid, and you may join mutually. Moreover, the both sides of 1 / 2lambda plate 406, and the polarization demarcation membrane 304 are formed on the parallel plate 409 for maintenance, and the parallel plate 103 and the parallel plate 409 for maintenance may be stuck.

[0029] Drawing 5 is drawing showing the configuration of the 4th example of this invention.

[0030] This example establishes a polarization rotation means all over the parallel plate 103. At this example, the polarization demarcation membrane 504 which consisted of multilayers sees in the field by the side of the condenser lens 101 of the parallel plate 103 formed at the include angle of 45 degrees to the optical axis of a condenser lens 101 from a direction 45 degrees, and it is prepared in it by the width of face of the flux of light and the width of face of abbreviation identitas which are the pitch of the cylindrical microlenses 1011-1013, and were condensed by each cylindrical microlens. On the other hand, film-like 1 / 4lambda plate 506 are formed in the whole surface, and further, the parallel plate 510 for maintenance with which the aluminum total reflection film 505 was vapor-deposited by the whole surface is formed in the field by the side of the anti-condenser lens 101 of the parallel plate 103 so that the aluminum total reflection film 505, and the 1 / 4lambda plate 506 may counter.

[0031] By considering as the above configurations, since what is necessary is just to attach film-like 1 / 4lambda plate 506 to the whole surface, a work process can be simplified.

[0032] If the flux of light 102 which carries out incidence to a polarization sensing element is made into abbreviation parallel light, flux of light width of face is compressed by each cylindrical microlenses 1011-1013 which constitute a condenser lens 101, S polarization 102S will be reflected by the polarization demarcation membrane 504 prepared in the field by the side of the condenser lens 101 of the parallel plate 103, and P polarization 102P will penetrate by it. After becoming the circular polarization of light and being reflected by the aluminum total reflection film 505 by passing 1 / 4lambda plate 506 formed in the field by the side of the anti-incidence lens 101 of the parallel plate 103, by passing 1 / 4lambda plate 506 again, the polarization direction serves as S polarization rotated 90 degrees, and carries out outgoing radiation of the P polarization 102P transmitted from between the polarization demarcation membranes 504. The natural light which carried out incidence as mentioned above can be arranged with S polarization.

[0033] Drawing 6 is drawing showing the configuration of the 5th example of this invention.

[0034] This example establishes a polarization rotation means all over the parallel plate 103 like the 4th example shown in drawing 5 .

[0035] In this example, film-like 1 / 4lambda plate 606 are formed in the field by the side of the condenser lens 101 of the parallel plate 103 formed at the include angle of 45 degrees to the optical axis of a condenser lens 101 on the whole surface. On this 1 / 4lambda plate 606, the polarization demarcation membrane 604 is formed by the width of face of the flux of light and the width of face of abbreviation identitas which are the pitch of the cylindrical microlenses 1011-1013 seen from the direction 45 degrees, and were condensed by each cylindrical microlens, and, on the other hand, the aluminum total reflection film 605 is vapor-deposited by the field by the side of the anti-condenser lens 101 of the parallel plate 103 on the whole surface.

[0036] As mentioned above, a work process can be simplified by considering as the configuration which attaches film-like 1 / 4lambda plate 606 to the whole surface.

[0037] Flux of light width of face is compressed by each cylindrical microlenses 1011-1013 which constitute a condenser lens 101, S polarization 102S are reflected in the direction which intersects perpendicularly to incident light by the polarization demarcation membrane 604 prepared in the field by the side of the condenser lens 101 of the parallel plate 103, and P polarization 102P penetrate the flux of light 102 which carries out incidence to a polarizing element by it. P polarization 102P transmitted become the circular polarization of light by passing 1 / 4lambda plate 606, and after being reflected by the aluminum total reflection film 605 prepared in the field by the side of the anti-condenser lens 101 of the parallel plate 103, by passing 1 / 4lambda plate 606

again, the polarization direction serves as S polarization rotated 90 degrees, and carries out outgoing radiation of them from between the polarization demarcation membranes 604.
[0038] The natural light which carried out incidence as mentioned above can be arranged with S polarization.
[0039] In addition, in this example, the illumination light from which it separated from the above-mentioned parallel light into the part by the side of the condenser lens 101 of the parallel plate 103 is interrupted, and outgoing radiation light forms a gobo 612 in outgoing radiation light and abbreviation parallel, and is improving the purity of polarization of outgoing radiation light so that it may let it pass, so that the illumination light from which it separated from parallel light may not turn into the stray light.
[0040] Drawing 7 is drawing showing the configuration of the 6th example of this invention.
[0041] This example combines minute prism with an parallel plate.
[0042] In the field by the side of the condenser lens 101 of the parallel plate 103 formed at the include angle of 45 degrees to the optical axis of a condenser lens 101 The pair of 1 / 2lambda plate 706 of the shape of the polarization demarcation membrane 704 which consisted of multilayers, and film in the pitch of the cylindrical microlenses 1011-1013 seen from the direction 45 degrees And each width of face is prepared by the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens, and the aluminum total reflection film 705 is formed in the field by the side of the anti-condenser lens 101 of the parallel plate 103 on the whole surface. Furthermore, the prism plate 708 which consists of minute prism 7081-7085 which has the flat surface of an abbreviation perpendicular to the flat surface and outgoing radiation light of an abbreviation perpendicular to the optical axis of a condenser lens 101 joins to the parallel plate 103, and is formed in the field by the side of the condenser lens 101 of the parallel plate 103.
[0043] If the flux of light 102 which carries out incidence to a polarizing element is made into abbreviation parallel light, flux of light width of face will be compressed by the cylindrical microlenses 1011-1013 which constitute a condenser lens 101, incidence will be carried out to the minute prism 7081-7085 which constitutes the prism plate 708, and it will separate into S polarization 102S and P polarization 102P by the polarization demarcation membrane 704 prepared in the field by the side of the condenser lens 101 of the parallel plate 103. S polarization 102S pass with each minute prism 7081 and 7083 and 7085 grades which reflect in the direction which intersects perpendicularly to incident light 102, and constitute the prism plate 708, and carry out outgoing radiation. By penetrating the polarization demarcation membrane 704, being reflected by the aluminum total reflection film 705 prepared in the field by the side of the anti-condenser lens 101 of the parallel plate 103, and passing 1 / 2lambda plate 706, the polarization direction serves as S polarization rotated 90 degrees, and P polarization 102P pass with the minute prism 7082 and 7084 grades which constitute the prism plate 708 further, and carry out outgoing radiation.
[0044] The natural light which carried out incidence as mentioned above can be arranged with S polarization.
[0045] If it is the configuration which prepares a polarization demarcation membrane into an optical medium like this example, a broadband can be covered and an extinction ratio can be made high.
[0046] Drawing 8 is drawing showing the configuration of the 7th example of this invention.
[0047] This example combines minute prism with an parallel plate like the 6th example shown in drawing 7 .
[0048] The polarization demarcation membrane 804 constituted from multilayers by the field by the side of the condenser lens 101 of the parallel plate 103 formed at the include angle of 45 degrees to the optical axis of a condenser lens 101 is formed in the whole surface, and the aluminum total reflection film 805 is formed in the field by the side of the anti-condenser lens 101 on the whole surface. Furthermore, the prism plate 808 which consists of minute prism 8081-8085 which has the flat surface of an abbreviation perpendicular to the flat surface and outgoing radiation light of an abbreviation perpendicular to the optical axis of a condenser lens 101 joins to the parallel plate 103, and is formed in the field by the side of the condenser lens 101 of the parallel plate 103.
[0049] Film-like 1 / 2lambda plate 806 are formed in each outgoing radiation section of the minute prism 8082 and 8084 grades located in the middle of each cylindrical microlens among the minute prism 8081-8085 which constitutes the prism plate 808, respectively, and the protection-from-light member 812 is formed in the field perpendicular to the outgoing radiation section, respectively.
[0050] By considering as the above configurations, the natural light which carried out incidence like the 6th example shown in drawing 7 could be arranged with S polarization, further, by having formed the protection-

from-light member 812, the stray light could be removed and the extinction ratio was able to be made high.
[0051] Drawing 9 is drawing showing the configuration of the 8th example of this invention, and is applied to the polarizing element of a transparency mold.
[0052] The polarizing element of this example consists of a condenser lens 901 of the resin mold goods which consist of cylindrical microlenses 9011-9013 which have the function of an afocal converter, and an parallel plate 903 arranged so that it may have the include angle whose flat-surface section is 45 degrees to the optical axis of this condenser lens 901. In the field by the side of the anti-condenser lens 901 of the parallel plate 903, the pair of 1 / 2lambda plate 906 of the shape of the polarization demarcation membrane 904 which consisted of multilayers, and film It is the pitch of the cylindrical microlenses 9011-9013 seen from the direction 45 degrees. And the flux of light by which each width of face was condensed by each cylindrical microlens is also established by width of face and the width of face of abbreviation identitas. In the field by the side of the condenser lens 901 of the parallel plate 903, the aluminum total reflection film 905 It is the pitch of the cylindrical microlenses 9011-9013 seen from the direction 45 degrees, and it is prepared so that each width of face may turn into the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens.
[0053] If the flux of light 902 which carried out incidence to the polarizing element is made into abbreviation parallel light, flux of light width of face will be compressed by the cylindrical microlenses 9011-9013 which constitute a condenser lens 901, and incidence of the flux of light 902 will be carried out to the polarization demarcation membrane 904 prepared in the field by the side of the anti-condenser lens 901 of the parallel plate 903 through between the aluminum total reflection film 905 prepared in the condenser lens 901 side of the parallel plate 903. The flux of light 902 which carried out incidence to the polarization demarcation membrane 904 is divided into P polarization 902P and S polarization 902S. P polarization 902P penetrate the polarization demarcation membrane 902, and outgoing radiation is carried out. On the other hand, it is reflected by the high reflective aluminum total reflection film 905 which reflected and was prepared in the condenser lens 901 side of the parallel plate 903, and outgoing radiation of S polarization 902S is carried out through 1 / 2lambda plate 906 formed in the anti-condenser lens 901 side of the parallel plate 903. By passing along this 1 / 2lambda plate 906, the polarization direction rotates 90 degrees and outgoing radiation is carried out as P polarization.
[0054] The natural light which carried out incidence as mentioned above can be arranged with P polarization.
[0055] Drawing 10 is drawing showing the configuration of the 9th example of this invention, and is applied to the polarizing element of a transparency mold like the 8th example shown in drawing 9 .
[0056] This example is the pitch of the cylindrical microlenses 9011-9013 which looked at film-like 1 / 2lambda plate 1006 from the direction 45 degrees to the anti-condenser lens 901 side of the parallel plate 903, and it was prepared so that each width of face might turn into the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens, and it formed the polarization demarcation membrane 104 which similarly consisted of multilayers all over the anti-condenser lens 901 side of the parallel plate 903. the width of face of the flux of light from which the total reflection film 1005 of aluminum (or silver) is the pitch of the cylindrical microlenses 9011-9013 seen from the direction 45 degrees, and each width of face was condensed by each cylindrical microlens on the other hand by the field by the side of the condenser lens 901 of the parallel plate 903, and abbreviation -- it is prepared so that it may become the same width of face. Since other configurations are the same as that of the 8th example shown in drawing 9 , the same number is attached and explanation is omitted.
[0057] By considering as the above configurations, the natural light which carried out incidence like the 8th example shown in drawing 9 can be arranged with P polarization. Moreover, in the thing of this example, since the polarization demarcation membrane is prepared in the whole surface, when forming this, there is no need of carrying out a mask, and a production process can be simplified. Moreover, since the polarization demarcation membrane is prepared in the whole surface and incident light turns into outgoing radiation light through a polarization demarcation membrane altogether, the polarization ratio of outgoing radiation light also has the effectiveness of becoming still better.
[0058] Drawing 11 is drawing showing the configuration of the 10th example of this invention, and is applied to the polarizing element of a transparency mold like the 8th and 9th examples shown in drawing 9 and drawing 10 .
[0059] This example is the pitch of the cylindrical microlenses 9011-9013 which looked at the polarization

demarcation membrane 1104 from the direction 45 degrees to the field by the side of the anti-condenser lens 901 of the parallel plate 903. It prepares so that each width of face may turn into the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens. On the other hand, and in the field by the side of the condenser lens 901 of the parallel plate 903 It is the pitch of the cylindrical microlenses 9011-9013 which formed film-like 1 / 4lambda plate 1106, and looked at the total reflection film 1105 of aluminum (or silver) from the direction 45 degrees on 1 / 4lambda plate 1106 to the pan. And it prepares so that each width of face may turn into the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens. Moreover, the absorption member 1116 for carrying out absorption removal of the unnecessary light is formed in the both sides of the polarization demarcation membrane 1104 by the side of the anti-condenser lens 901. Since other configurations are the same as that of the 8th [which was shown in drawing 9 and drawing 10 , respectively], and 9th example capitals, the same number is attached and explanation is omitted.

[0060] Since what is necessary is just to form film-like 1 / 4lambda plate 1106 in the whole surface by considering as the above configurations, a production process can be simplified.

[0061] Drawing 12 is drawing showing the configuration of the 11th example of this invention.

[0062] In this example, a condenser lens 1301 is constituted by the cylindrical microlenses 13011-13013, and the parallel plate 903 is formed at the include angle of 45 degrees to the optical axis of a condenser lens 1301. 1 / 2lambda plate 1306 is formed in the field by the side of the anti-condenser lens 1301 of the parallel plate 903, and the polarization demarcation membrane 1304 which consisted of multilayers on it is formed in the whole surface. Moreover, the aluminum total reflection film 1305 with which high reflective processing was performed is formed in the field by the side of the condenser lens 1301 of the parallel plate 903. It is the pitch of the cylindrical microlenses 13011-13013 which looked at both these 1 / 2lambda plates 1306 and the aluminum total reflection film 1305 from the direction 45 degrees, and it is prepared so that each width of face may turn into the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens. The parallel plate 903 is formed in the wrap outgoing radiation side prism plate 1307 and the incidence side prism plate 1308 over the whole surface in the upper part of these polarization demarcation membranes 1304 and the aluminum total reflection film 1305, respectively. The outgoing radiation side prism plate 1307 consists of minute prism 13071-13075, and the incidence side prism plate 1308 consists of minute prism 13081-13083. Both [these minute prism 13071-13075 and] 13081-13083 have a perpendicular flat surface (outgoing radiation section) and an parallel flat surface to the optical axis of a condenser lens 1301, two minute prism which constitutes the outgoing radiation side prism plate 1307 is formed at a time to each cylindrical microlens, and one minute prism which constitutes the incidence side prism plate 1308 is formed at a time. In order for the cylindrical microlenses 13011-13013 which constitute a condenser lens 1301 to prevent the light from which it separated from parallel light turning into loss light, it is constituted so that each cylindrical microlenses 13011-13013 may have a level difference, may be arranged and may approach the minute prism 13081-13083 corresponding to each.

[0063] If the flux of light 902 which carries out incidence to the polarizing element constituted as mentioned above is made into the parallel flux of light Incidence of the flux of light 902 is carried out to the minute prism 13081-13083 which is compressed into one half of width of face by the cylindrical microlenses 13011-13013 which constitute a condenser lens 1301, and constitutes the incidence side prism plate 1308 by them. It is separated into P polarization 902P and S polarization 902S by the polarization demarcation membrane 1304 prepared in the field by the side of the anti-condenser lens 1301 of the parallel plate 903 after passing along the clearance between the aluminum total reflection film 1305 established in the field by the side of the condenser lens 1301 of the parallel plate 903. P polarization 902P penetrate this polarization demarcation membrane 1304, and it carries out outgoing radiation through the minute prism 13071 and 13073 grades which constitute the outgoing radiation side prism plate 1307. On the other hand, after being reflected in the direction which intersects perpendicularly with incident light and being reflected by the aluminum total reflection film 1305 prepared in the field by the side of the condenser lens 1301 of the parallel plate 903, outgoing radiation of S polarization 902S is carried out to order through the minute prism 13072 and 13074 grades which constitute 1 / 2lambda plate 1306, the polarization light demarcation membrane 1304, and the outgoing radiation side prism plate 1307. Since the polarization direction rotates 90 degrees and serves as P polarization in case it passes along this 1 / 2lambda plate 1306, all outgoing radiation light turns into P polarization.

[0064] The natural light which carried out incidence as mentioned above can be arranged with P polarization. Moreover, this example also has the effectiveness that a polarization ratio becomes good further.
[0065] Drawing 13 is drawing showing the configuration of the 12th example of this invention.
[0066] Using the conversion units 14011-14013 which have the same configuration as the example shown in drawing 12 , each edge of the unit of these plurality is arranged, and this example is installed in parallel, and plans space-saving.
[0067] By considering as such a configuration, the dimension of the occupied volume of a polarization sensing element, especially the direction of an optical axis of a condenser lens can be made small. For example, by dividing into three units which are illustrated, the dimension of the direction of an optical axis of a condenser lens can be made into abbreviation 1/3, and it can contribute to the miniaturization of the image projection equipment equipment constituted using this.
[0068] In addition, although it took to each example and being explained as a thing using 1 / 2lambda plate as a polarization rotation means, it is good also as what rotates the polarization direction using plane-of-polarization slewing gears which pass along 1 / 4lambda plate twice, such as a configuration, matter made from the rotatory polarization, such as a liquid crystal plate, and a Faraday cell.
[0069] Moreover, although explained as a condenser lens which consists of cylindrical microlenses about an illumination system, it is good also as what this illumination system equips with the light source section which put many light emitting devices in order, and the fly eye lens which equalizes or divides into plurality the light generated in the light source section.
[0070] Moreover, although especially the optical surface of the cylindrical microlens which constitutes a condenser lens was not described, by considering as the aspheric surface, the condensing engine performance can be improved and loss of perfume and generating of flare light can be decreased sharply.
[0071] Speaking of a condensing member, a condensing member may consist of prism. Moreover, a condensing member may be used as the lens for rotation, and you may arrange in the shape of a checker. In this case, what is necessary is to just be arranged according to the array condition of the above-mentioned condensing member about what is discretely arranged among a total reflection mirror, a polarization demarcation membrane, and polarization rotation means (1 / 2lambda plate).
[0072] Moreover, the image projection equipment by each polarization unit shown in drawing 3 - drawing 13 becomes the thing equipped with each above-mentioned effectiveness.
[0073] Drawing 14 is drawing showing the configuration of the 13th example of this invention.
[0074] The polarizing element of this example consists of parallel plates 2903 arranged so that it may have the include angle whose flat-surface section is 45 degrees to the condenser lens 2901, this condenser lens 2901, and optical axis of the resin mold goods which consist of cylindrical microlenses 29011-29013 which have the function of an afocal converter. It has power negative in the field by the side of outgoing radiation for power forward [each / of these cylindrical microlenses 29011, 29012, and 29013] in the field by the side of incidence, negative power has power twice the magnitude of forward, and the incident light which is parallel light has the function of the afocal converter by which outgoing radiation is carried out by becoming the parallel light of the width of face of 1/the 2. It is the pitch of the cylindrical microlenses 29011-29013 as which the aluminum total reflection film 2905 carried out regarded high reflective processing from the direction 45 degrees at the field by the side of the condenser lens 2901 of the parallel plate 2903, and it is prepared in the shape of a stripe so that each width of face may turn into the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens. Film-like 1 / 4lambda plate 2906 are formed in the field by the side of the anti-condenser lens 2901 of the parallel plate 2903 all over abbreviation, and the polarization demarcation membrane 2904 constituted from multilayers by the pan on 1 / 4lambda plate 2906 is too formed all over abbreviation.
[0075] If the flux of light 2902 which carried out incidence to the polarizing element is made into abbreviation parallel light, compression separation of the flux of light width of face is carried out by the cylindrical microlenses 29011-29013 which constitute a condenser lens 2901, and after the flux of light 2902 penetrates 1 / 4lambda plate 2906 formed in the field by the side of the anti-condenser lens 2901 of the parallel plate 2903 through between the aluminum total reflection film 2905 prepared in the condenser lens 2901 side of the parallel plate 2903 in the shape of a stripe, incidence of it will be carried out to the polarization demarcation membrane 2904. The flux of light 2902 which carried out incidence to the polarization demarcation membrane

2904 is divided into P polarization 2902P and S polarization 2902S. P polarization 2902P penetrate the polarization demarcation membrane 2904, and outgoing radiation is carried out. On the other hand, after being changed into the circular polarization of light through 1 / 4lambda plate 2906 which reflected and was formed in the anti-condenser lens 2901 side of the parallel plate 2903, it is reflected by the high reflective aluminum total reflection film 2905 prepared in the condenser lens 2901 side of the parallel plate 2903, and outgoing radiation of S polarization 2902S is carried out through 1 / 4lambda plate 2906 further formed in the anti-condenser lens 2901 side of the parallel plate 2903. When it passes along this 1 / 4lambda plate 2906 both ways, the polarization direction rotates 90 degrees and outgoing radiation is carried out as P polarization.
[0076] Thus, the natural light which carried out incidence can be arranged with P polarization.
[0077] Since what is necessary is just to form the difficult polarization demarcation membrane 2904 of pattern formation, and the film-like 1 / 4lambda plate 2906 in the whole surface by considering as the above configurations, a production process can be simplified. It is easy to vapor-deposit the aluminum total reflection film 2905 in the shape of a stripe, and to prepare it.
[0078] Drawing 15 is drawing showing the configuration of the image projection equipment with which the polarizing element constituted as mentioned above was incorporated.
[0079] Outgoing radiation of the parallel flux of light with various the polarization directions which the light source 2250 generates is changed and carried out only to P polarization by the polarizing element shown in drawing 14 .
[0080] Each of the dichroic mirrors 2251, 2252, 2258, and 2259 in this example, total reflection mirrors 2253 and 2257, the liquid crystal light valves 2254, 2255, and 2256, and the projection lens 2260 is constituted like the dichroic mirrors 1551, 1552, 1558, and 1559 shown in drawing 17 , total reflection mirrors 1553 and 1557, the liquid crystal light valves 1554, 1555, and 1556, and a projector lens 1560.
[0081] Each of the liquid crystal light valves 2254, 2255, and 2256 generates an image by modulating two or more liquid crystal devices built in according to the video signal inputted from the image generator (un-illustrating) which consists of three generators made to generate the image of each color of RGB. Each of dichroic mirrors 2251, 2252, 2258, and 2259 constitutes the color-separation system which decomposes into the flux of light of three colors of RGB the illumination light changed only into P polarization by the polarizing element shown in drawing 14 .
[0082] Since the quantity of light loss in each liquid crystal light valves 2254, 2255, and 2256 is lost, a projection image can be made bright, and it stops also producing generating of heat by the absorption of light by considering as the above-mentioned configuration. In this case, it becomes unnecessary to prepare the polarizing plate by the side of the incidence of a liquid crystal light valve, and you may constitute in this way. Moreover, since it can be made the form in which P polarization carries out incidence to each dichroic mirror if it is made such a configuration, color-separation-composition can be performed efficiently.
[0083] Drawing 16 is drawing showing the configuration of the 15th example of this invention.
[0084] In this example, a condenser lens 2301 is constituted by the cylindrical microlenses 23011-23013, and the parallel plate 2103 is formed at the include angle of 45 degrees to the optical axis of a condenser lens 2301. The polarization demarcation membrane 2304 constituted from multilayers by the field by the side of the anti-condenser lens 2301 of the parallel plate 2103 is formed in the whole surface. 1 / 4lambda plate 2306 is formed in the field by the side of a condenser lens 2301, and, as for the parallel plate 2103, the aluminum total reflection film 2305 with which high reflective processing was performed is formed in the top face of 1 / 4lambda plate 2306 in the shape of a stripe. The aluminum total reflection film 2305 prepared in the shape of a stripe is the pitch of the cylindrical microlenses 23011-23013 seen from the direction 45 degrees, and it is prepared so that each width of face may turn into the width of face of the flux of light and the width of face of abbreviation identitas which were condensed by each cylindrical microlens. The parallel plate 2103 is formed in the wrap outgoing radiation side prism plate 2307 and the incidence side prism plate 2308 over the whole surface in the upper part of these polarization demarcation membranes 2304 and the aluminum total reflection film 2305, respectively. The outgoing radiation side prism plate 2307 consists of minute prism 23071-23075, and the incidence side prism plate 2308 consists of minute prism 23081-23083. Both [these minute prism 23071-23075 and] 23081-23083 have a perpendicular flat surface (outgoing radiation section) and an parallel flat surface to the optical axis of a condenser lens 2301, two minute prism which constitutes the outgoing radiation side prism plate 2307 is formed at a time to each cylindrical microlens, and one minute prism which

constitutes the incidence side prism plate 2308 is formed at a time. In order for the cylindrical microlenses 23011-23013 which constitute a condenser lens 2301 to prevent the light from which it separated from parallel light turning into loss light, it is constituted so that each cylindrical microlenses 23011-23013 may have a level difference, may be arranged and may approach the minute prism 23081-23083 corresponding to each.
[0085] If the flux of light 2102 which carries out incidence to the polarizing element constituted as mentioned above is made into the parallel flux of light Incidence of the flux of light 2102 is carried out to the minute prism 23081-23083 which is compressed into one half of width of face by the cylindrical microlenses 23011-23013 which constitute a condenser lens 2301, and constitutes the incidence side prism plate 2308 by them. It is separated into P polarization 2102P and S polarization 2102S by the polarization demarcation membrane 2304 prepared in the field by the side of the anti-condenser lens 2301 of the parallel plate 2103 after passing along the clearance between the aluminum total reflection film 2305 established in the field by the side of the condenser lens 2301 of the parallel plate 2103 in the shape of a stripe. P polarization 2102P penetrate this polarization demarcation membrane 2304, and it carries out outgoing radiation through the minute prism 23071 and 23073 grades which constitute the outgoing radiation side prism plate 2307. On the other hand, although it is reflected in the direction which intersects perpendicularly with incident light, and 1 / 4lambda plate 2306 formed in the field by the side of the condenser lens 2301 of the parallel plate 2103 are penetrated and it is reflected by the aluminum total reflection film 2305, S polarization 2102S penetrate 1 / 4lambda plate 2306 to a pan, and outgoing radiation is carried out to order through the minute prism 23072 and 23074 grades which constitute the outgoing radiation side prism plate 2307. Since the polarization direction rotates 90 degrees and serves as P polarization in case it passes along this 1 / 4lambda plate 2306 both ways, all outgoing radiation light turns into P polarization.
[0086] The natural light which carried out incidence as mentioned above can be arranged with P polarization.
[0087] In addition, although explained as a configuration which passes along 1 / 4lambda plate twice as a polarization rotation means in each example, it is good also as what rotates the polarization direction using plane-of-polarization slewing gears, such as matter made from the rotatory polarization, such as a liquid crystal plate, and a Faraday cell. Moreover, even if it does not prepare the polarization direction rotation means, a polarization demarcation membrane, and a total reflection mirror in an parallel plate directly, they are good also as a configuration which forms in 2nd another thin parallel plate, and is pasted up on said parallel plate. The direction of it may be high unreliable.
[0088] Moreover, although explained as a condenser lens which consists of cylindrical microlenses about an illumination system, it is good also as what this illumination system equips with the light source section which put many light emitting devices in order, and the fly eye lens which equalizes or divides into plurality the light generated in the light source section.
[0089] Moreover, although especially the optical surface of the cylindrical microlens which constitutes a condenser lens was not described, by considering as the aspheric surface, the condensing engine performance can be improved and loss of the quantity of light and generating of flare light can be decreased sharply.
[0090] Speaking of a condensing member, a condensing member may consist of prism. Moreover, a condensing member may be used as the lens of the symmetry of revolution, and you may arrange in the shape of a checker. In this case, what is necessary is to just be arranged according to the array condition of the above-mentioned condensing member about what is discretely arranged like a total reflection mirror.
[0091]
[Effect of the Invention] Since this invention is constituted as explained above, effectiveness which is indicated below is done so.
1. Incident light can be used efficiently and there is effectiveness which can make the projection image of image projection equipment bright.
2. The difficult polarization demarcation membrane of forming in the shape of a pattern and the component (film) which a polarization rotation operation produces can be prepared on parallel monotonous on the whole surface, and the direction and polarization condition of light can be arranged with an easy configuration on the configuration of forming the easy aluminum total reflection film of vapor-depositing in the shape of a pattern on a stripe, and manufacture.
3. Small and can suppose that it is lightweight and according to this image projection equipment can be miniaturized for a polarization conversion unit.

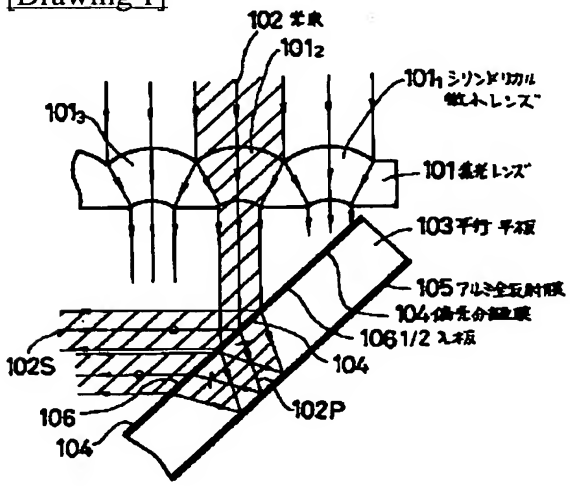
[Translation done.]

* NOTICES *

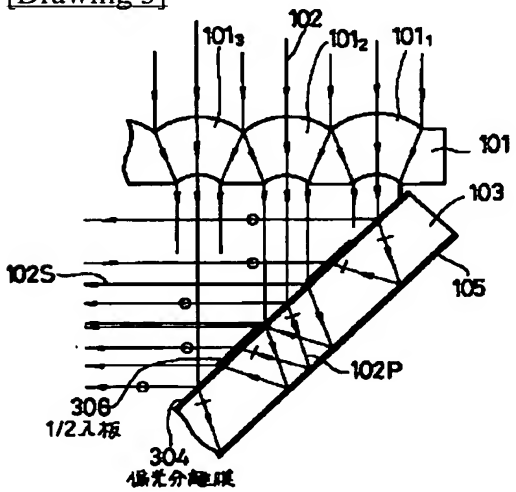
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

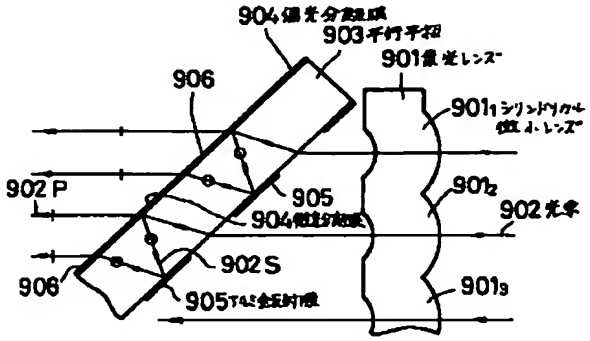
[Drawing 1]



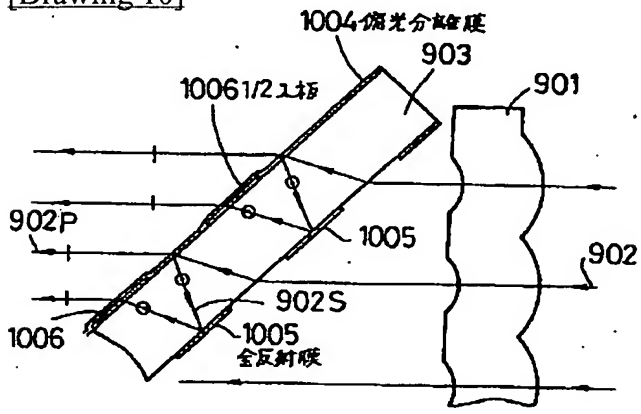
[Drawing 3]



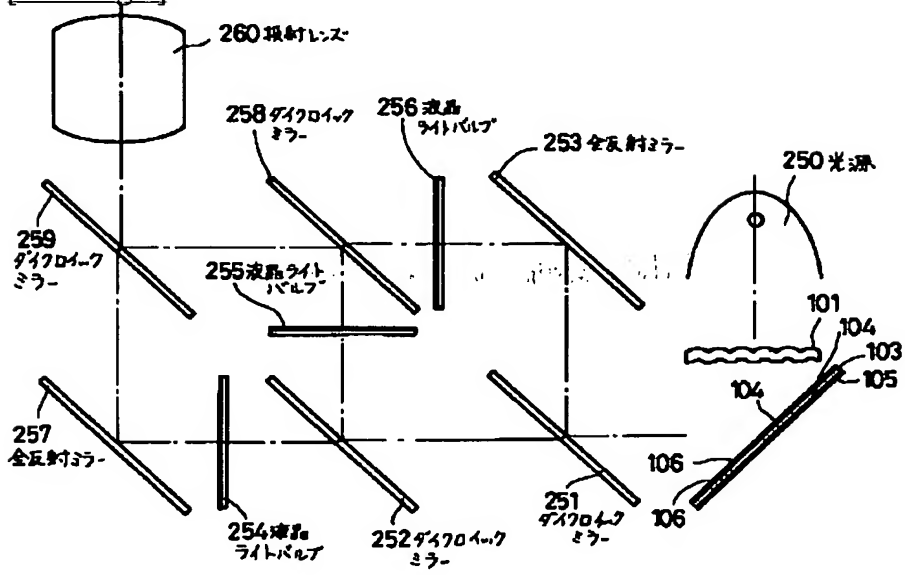
[Drawing 9]



[Drawing 10]



[Drawing 2]



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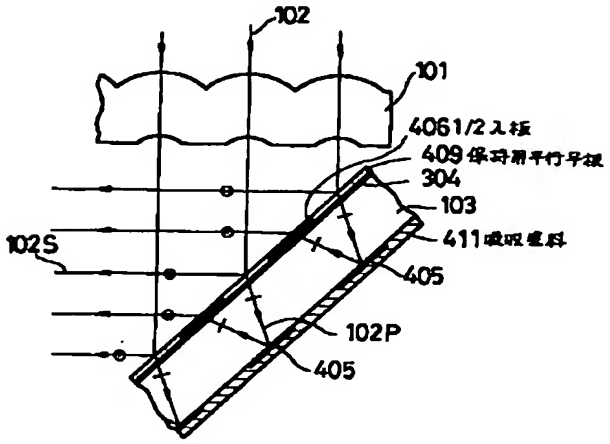
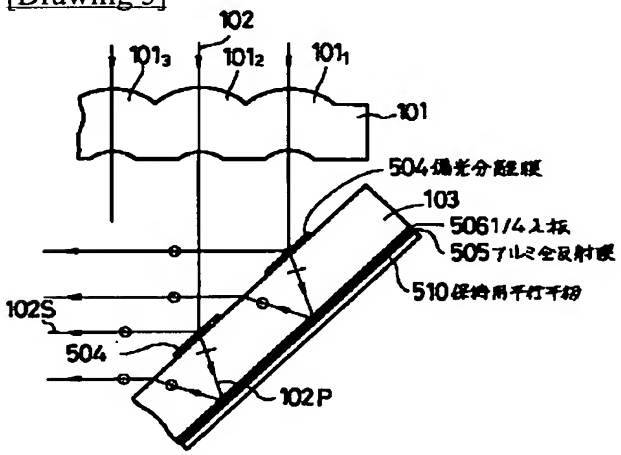
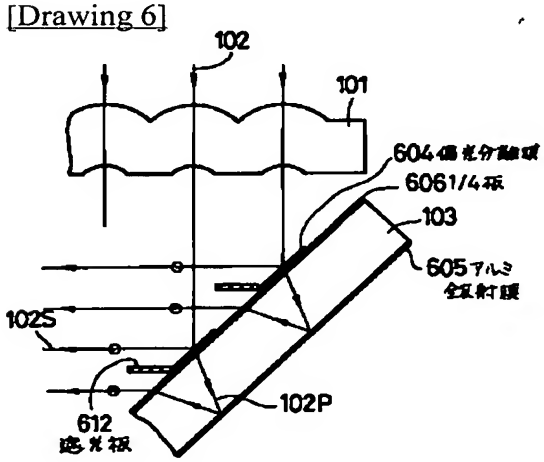


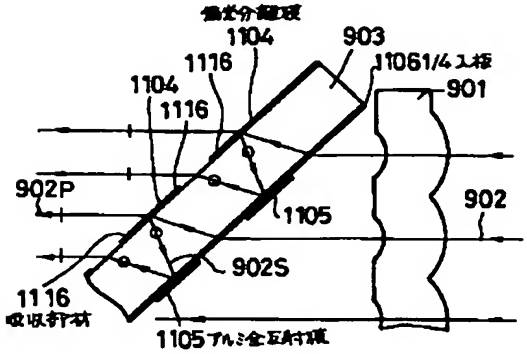
[Drawing 5]



[Drawing 6]



[Drawing 11]



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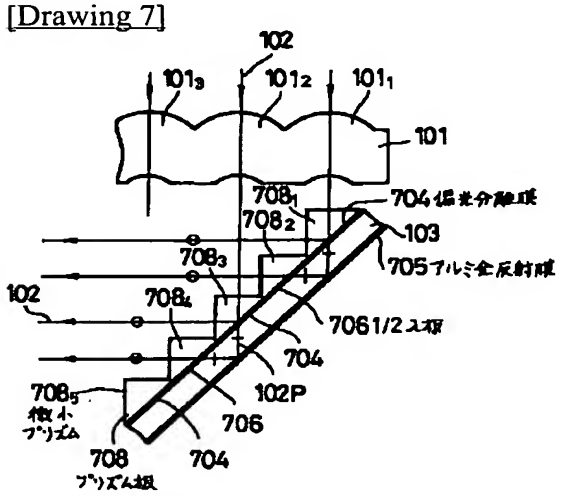
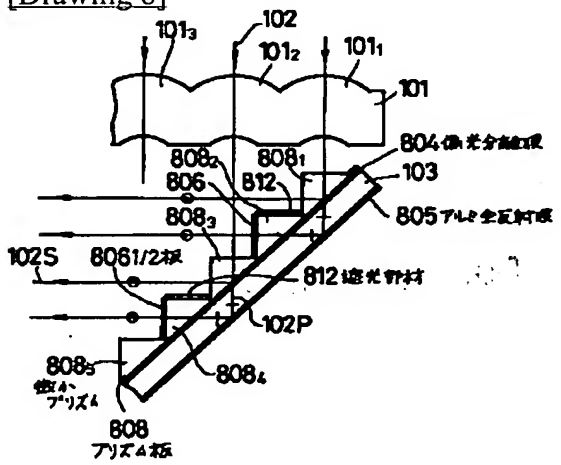
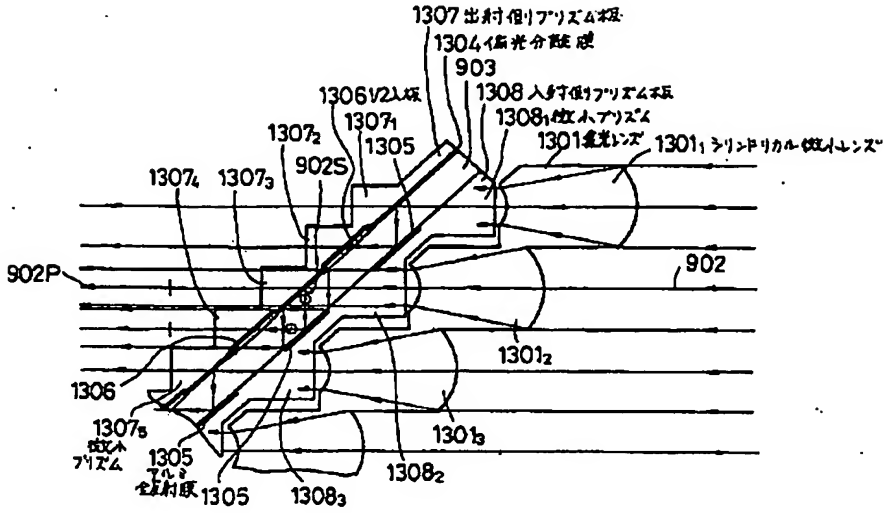


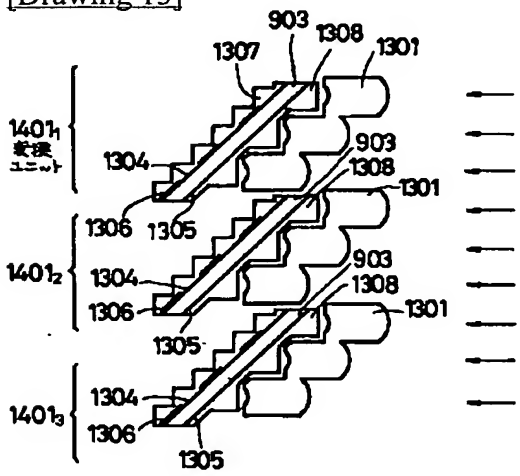
[Drawing 8]



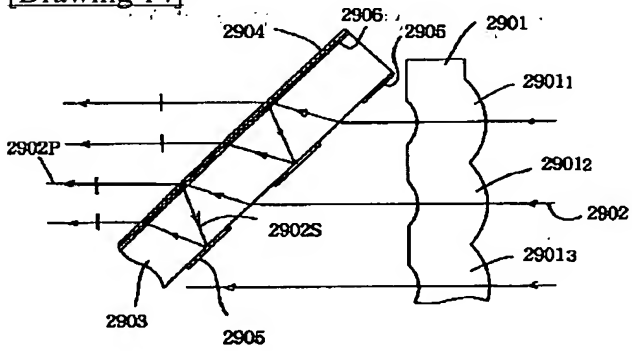
[Drawing 12]



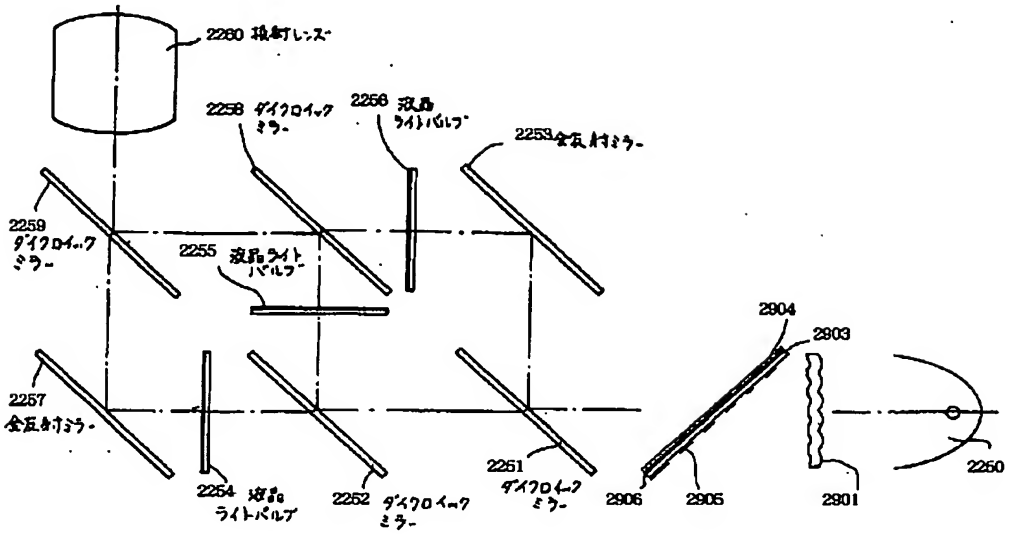
[Drawing 13]



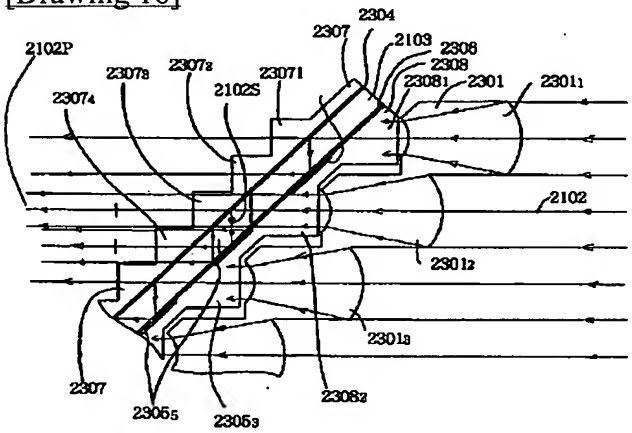
[Drawing 14]



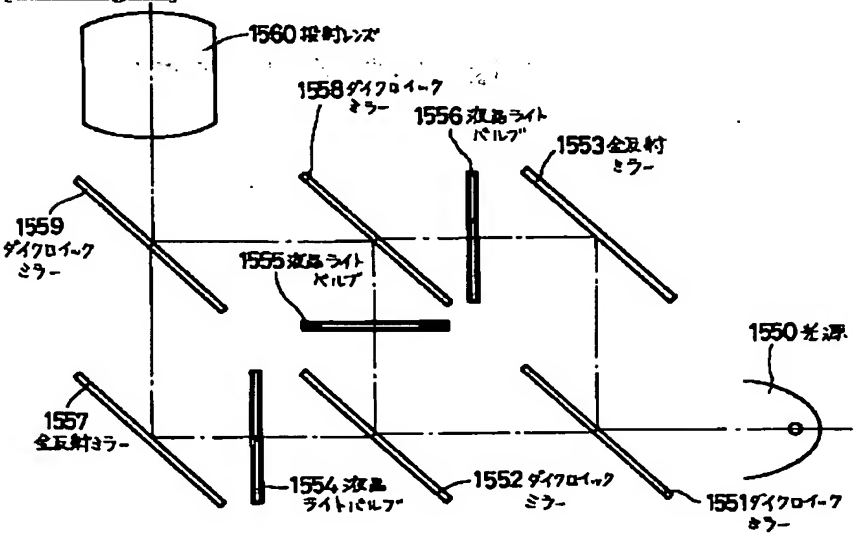
[Drawing 15]



[Drawing 16]



[Drawing 17]



[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 2nd partition of the 6th section
[Publication date] July 2, Heisei 11 (1999)

[Publication No.] Publication number 5-107505
[Date of Publication] April 30, Heisei 5 (1993)
[Annual volume number] Open patent official report 5-1076
[Application number] Japanese Patent Application No. 4-87211
[International Patent Classification (6th Edition)]

G02B 27/28
5/30
G02F 1/13 505
1/1335 510
1/1347
G03B 33/12
H04N 5/74

[FI]

G02B 27/28 Z
5/30
G02F 1/13 505
1/1335 510
1/1347
G03B 33/12
H04N 5/74 A

[Procedure revision]
[Filing Date] April 13, Heisei 10
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] The name of invention
[Method of Amendment] Modification
[Proposed Amendment]
[Title of the Invention] Image equipment and image projection equipment equipped with a polarization conversion unit equipped with a tabular polarizing element and this component, and this unit
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]

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[Claim 1] One field of a transparence parallel plate is equipped with the polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which carries out incidence to this parallel plate from the one [this] field or field side of another side. The tabular polarizing element characterized by reflecting in the reflector which prepared one light of this reflected light and the transmitted light in the field of said another side of this transparence parallel plate, changing the plane of polarization of one [at least] light of this reflected light and the transmitted light towards an optical path almost parallel to the optical path of the light of another side, and making the plane of polarization of both light in agreement.
[Claim 2] The tabular polarizing element of claim 1 characterized by forming 1 / 2lambda film in the predetermined part of one [said] field of said transparence parallel plate in order to change the plane of polarization of one light of said reflected light and the transmitted light and to make it in agreement with the plane of polarization of the light of another side.
[Claim 3] The tabular polarizing element of claim 1 characterized by arranging 1 / 2lambda plate near one [said] field of said transparence parallel plate in order to change the plane of polarization of one light of said reflected light and the transmitted light and to make it in agreement with the plane of polarization of the light of another side.
[Claim 4] The tabular polarizing element of claim 1 characterized by forming 1 / 4lambda film in the field of said one side of said transparence parallel plate, or another side in order to change the plane of polarization of one light of said reflected light and the transmitted light and to make it in agreement with the plane of polarization of the light of another side.
[Claim 5] Reflect in the reflector which is characterized by providing the following and which prepared one light of the grid-like reflected light which has a transparence parallel plate and was produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. The polarization conversion unit characterized by changing the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement The illumination system which supplies grid-like unpolarized light light It has the polarizing element installed to the optical axis of this illumination system so it may make this unpolarized light light change into an almost dense polarization light, and this polarizing element is a polarization demarcation membrane to one field.
[Claim 6] The polarization conversion unit of claim 5 characterized by equipping said illumination system with the light source section which put many light emitting devices in order, and a fly eye lens.
[Claim 7] The polarization conversion unit of claim 5 characterized by equipping said illumination system with the fly eye lens which divides the light from the light source into plurality.
[Claim 8] The polarization conversion unit of claim 5 characterized by the thing of the field of another side of said transparence parallel plate for which the reflective film is mostly formed in the whole surface.
[Claim 9] The polarization conversion unit of claim 5 characterized by the thing of one field of said transparence parallel plate for which said polarization demarcation membrane is mostly formed in the whole surface.
[Claim 10] Said polarizing element receives said grid-like unpolarized light light in respect of one side of said transparence parallel plate. Said grid-like transmitted light is turned to the field of another side of said transparence parallel plate from said polarization demarcation membrane. The polarization conversion unit of claim 9 characterized by forming 1 / 2lambda plate in the shape of a grid in order to change the plane of polarization of said grid-like transmitted light reflected in respect of another side of said transparence parallel plate on said polarization demarcation membrane and to make it in agreement with the plane of polarization of said grid-like reflected light.
[Claim 11] The polarization conversion unit of claim 10 characterized by the thing of the field of another side of said transparence parallel plate for which the reflective film is mostly formed in the whole surface.
[Claim 12] Said polarizing element receives said grid-like unpolarized light light in respect of one side of said transparence parallel plate. Said grid-like transmitted light is turned to the field of another side of said transparence parallel plate from said polarization demarcation membrane. said grid-like transmitted light -- said transparence -- in agreement with the plane of polarization of said grid-like reflected light, while making it reflect in respect of parallel monotonous another side -- it should make -- said transparence -- the polarization conversion unit of claim 5 characterized by the thing of the field of parallel monotonous another side for which

1 / 4lambda plate, and the reflective film are mostly formed in the whole surface.
[Claim 13] Said polarizing element receives said grid-like unpolarized light light in respect of one side of said transparence parallel plate. Form said polarization demarcation membrane in the shape of a grid, and said grid-like transmitted light is turned to the field of another side of said transparence parallel plate from said polarization demarcation membrane. said transparence -- parallel -- monotonous -- on the other hand, a field -- said transparence -- the polarization conversion unit of claim 5 characterized by forming 1 / 2lambda film in the shape of a grid by turns [said / polarization demarcation membrane and by turns] in order to make in agreement with the plane of polarization of said grid-like transmitted light the plane of polarization of said grid-like reflected light reflected in respect of parallel monotonous another side.
[Claim 14] The light source which emits unpolarized light light The illumination-light study system which changes the unpolarized light light from this light source into polarization light, the image generator made to generate an image by modulating this polarization light according to a video signal, and projection optics which projects this image The conversion system from which it is image projection equipment equipped with the above, and said illumination-light study system changes said unpolarized light light into an optical grid-like pattern, It has the polarizing element installed to the optical axis of this conversion system so it might make this grid-like light pattern change into polarization light almost densely. It has the transparence parallel plate with which this polarizing element equipped one field with the polarization demarcation membrane. Reflect in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. It is characterized by changing the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement.
[Claim 15] The light source which emits unpolarized light light The illumination-light study system which changes the unpolarized light light from this light source into polarization light The image generator made to generate an image by modulating this polarization light according to a video signal Projection optics which projects this image Are image projection equipment equipped with the above, and said image generator has three generators made to generate the image of each color of RGB. It has the color-separation system to which said illumination-light study system decomposes said unpolarized light light into the unpolarized light light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this grid-like light pattern which change unpolarized light light into an optical grid-like pattern at each optical path of the unpolarized light light of three colors of this RGB change into polarization light almost densely. Each of this polarizing element has the transparence parallel plate which prepared the polarization demarcation membrane in one field. Reflect in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. It is characterized by changing the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement.
[Claim 16] The light source which emits unpolarized light light The illumination-light study system which changes the unpolarized light light from this light source into polarization light The image generator made to generate an image by modulating this polarization light according to a video signal Projection optics which projects this image Are image projection equipment equipped with the above, and said image generator has three generators made to generate the image of each color of RGB. It has the color-separation system to which said illumination-light study system decomposes said unpolarized light light into the unpolarized light light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this grid-like light pattern which change unpolarized light light into an optical grid-like pattern at each of the common optical path of the unpolarized light light of two colors in this RGB, and the optical path of the unpolarized light light of other Isshiki change into polarization light almost densely. Each of this polarizing element has the transparence parallel plate which equipped one field with the polarization demarcation membrane. Reflect in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and it turns to an optical path almost parallel to the optical path of the light of another side. It is characterized by changing the plane of polarization

of one [at least] light of this grid-like reflected light and the grid-like transmitted light, and making the plane of polarization of both light in agreement.
[Claim 17] The polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which carries out incidence to this parallel plate from the field side of another side of this parallel plate is prepared in one field of a transparence parallel plate all over abbreviation. It turns to an parallel optical path. this reflected light -- this -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- The tabular polarizing element characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by establishing a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.
[Claim 18] The tabular polarizing element of claim 17 characterized by these plane-of-polarization rotation means being 1 / 4lambda film which were prepared in one field of these parallel plates.
[Claim 19] The tabular polarizing element of claim 17 to which this plane-of-polarization rotation means is characterized by being an optically active substance.
[Claim 20] The tabular polarizing element of claim 17 characterized by having constituted this parallel plate from an optically active substance, and considering as said plane-of-polarization rotation means.
[Claim 21] Have the following and this polarizing element prepares the polarization demarcation membrane which divides the incident light which penetrates and carries out incidence of the field of another side of a this transparence parallel-from illumination system plate at the reflected light and the transmitted light at one field of a transparence parallel plate all over abbreviation. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- The tabular polarizing element unit characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector. The illumination system which supplies the stripe-like flux of light The polarizing element installed to the optical axis of this illumination system so it might make this flux of light change into an almost dense polarization light
[Claim 22] Claim 5 or 21 polarization conversion units which are characterized by equipping said illumination system with the light source section which put many light emitting devices in order, and a cylindrical lens.
[Claim 23] Claim 5 or 21 polarization conversion units which are characterized by equipping said illumination system with the cylindrical lens which divides the light from the light source into plurality.
[Claim 24] Light source The illumination-light study system which changes the flux of light from this light source into polarization light, the image generator made to generate an image by modulating this polarization light according to a video signal, and projection optics which projects this image The conversion system from which it is image projection equipment equipped with the above, and said illumination-light study system changes the flux of light from said light source in the shape of a stripe, It has the polarizing element installed to the optical axis of this conversion system so it might make this grid-like light pattern change into polarization light almost densely. This polarizing element prepares the polarization demarcation membrane which divides the incident light which penetrates and carries out incidence of the field of another side of a this transparence parallel-from illumination system plate at the reflected light and the transmitted light at one field of a transparence parallel plate all over abbreviation. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- It is characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.
[Claim 25] Light source The illumination-light study system which changes the flux of light from this light source into polarization light The image generator made to generate an image by modulating this polarization light according to a video signal Projection optics which projects this image Are image projection equipment equipped with the above, and said image generator has three generators made to generate the image of each

color of RGB. It has the color-separation system from which said illumination-light study system separates said flux of light into the flux of light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this stripe-like light pattern which change the flux of light into an optical stripe-like pattern at each optical path of the flux of light of three colors of this RGB change into polarization light almost densely. Each of this polarizing element prepares the polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which penetrates and carries out incidence of the field of another side of this transparence parallel plate from an illumination system all over abbreviation in one field of a transparence parallel plate. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- It is characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.
[Claim 26] Light source The illumination-light study system which changes the flux of light from this light source into polarization light The image generator made to generate an image by modulating this polarization light according to a video signal Projection optics which projects this image Are image projection equipment equipped with the above, and said image generator has three generators made to generate the image of each color of RGB. It has the color-separation system from which said illumination-light study system separates said flux of light into the flux of light of three colors of RGB. It has the polarizing element installed to the optical axis of this conversion system so this color-separation system might make the conversion system and this stripe-like light pattern which change the flux of light into an optical stripe-like pattern at each of the common optical path of the flux of light of two colors in this RGB, and the optical path of the flux of light of other Isshiki change into polarization light almost densely. Each of this polarizing element prepares the polarization demarcation membrane which divides into the reflected light and the transmitted light the incident light which penetrates and carries out incidence of the field of another side of this transparence parallel plate from an illumination system all over abbreviation in one field of a transparence parallel plate. It turns to an parallel optical path. this reflected light -- this transparence -- the reflector established in the field of said parallel monotonous another side in the intermittent form -- reflecting -- the optical path of this transmitted light, and abbreviation -- It is characterized by changing the plane of polarization of this reflected light, and making the plane of polarization of both light in agreement by considering as the configuration which establishes a plane-of-polarization rotation means to rotate plane of polarization, all over the abbreviation for this parallel plate between this polarization demarcation membrane and this reflector.
[Claim 27] Said polarizing element receives said grid-like unpolarized light light in respect of said another side of said transparence parallel plate. It separates into said grid-like transmitted light and said grid-like reflected light by the polarization demarcation membrane of one [said] field. Said grid-like reflected light is turned to the field of said another side of said transparence parallel plate. The polarization conversion unit according to claim 9 characterized by forming 1 / 2lambda plate in the shape of a grid in order to change the plane of polarization of said grid-like reflected light reflected in respect of another side of said transparence parallel plate on one [said] field and to make it in agreement with the plane of polarization of said grid-like transmitted light.

[Claim 28] The polarizing element characterized by to make both polarization directions in agreement by having the transparence plate which formed the polarization demarcation membrane in one field, and formed the reflective film in the field of another side, returning to said polarization demarcation membrane by reflecting the transmitted light of the reflected lights and the transmitted lights which were separated by the polarization demarcation membrane of one [said] field by the reflective film of the field of said another side, and changing one [at least] polarization direction of said transmitted light and reflected light.
[Claim 29] The polarizing element of claim 28 which arranges a rectangular-prism means so that a slant face may lap on one [said] field in one [said] field, is made to carry out incidence of the light to said transparence plate through one side of the field which intersects perpendicularly mutually [said rectangular-prism means], and is characterized by taking out the light from said transparence plate through another side of said field of said rectangular-prism means which intersects perpendicularly mutually.
[Claim 30] The polarizing element of claim 28 characterized by forming said polarization demarcation

membrane all over one [said] field, and forming said reflective film all over the field of said another side.
[Claim 31] The polarizing element of claim 28 characterized by forming said polarization demarcation membrane all over one [said] field, and forming said reflective film in the field of said another side intermittently.
[Claim 32] The polarizing element of claim 28 characterized by forming said polarization demarcation membrane in one [said] field intermittently, and forming said reflective film all over the field of said another side.
[Claim 33] The polarizing element of claim 28 characterized by therefore making the polarization direction of said transmitted light and said reflected light in agreement with rotating the polarization direction 90 degrees by letting lambda/2 plate pass for one side of said transmitted light and reflected light once.
[Claim 34] The polarizing element of claim 33 characterized by arranging the lambda/2 aforementioned plate on said transparence plate.
[Claim 35] The polarizing element of claim 33 characterized by arranging in the location where the lambda/2 aforementioned plate separated from said transparence plate.
[Claim 36] The polarizing element of claim 28 characterized by therefore making the polarization direction of said transmitted light and said reflected light in agreement with rotating the polarization direction 90 degrees by letting lambda/4 plate pass for one side of said transmitted light and reflected light twice.
[Claim 37] The polarizing element of claim 36 characterized by forming the lambda/4 aforementioned plate on said transparence plate.
[Claim 38] The polarization conversion unit characterized by having the polarizing element of either claim 28 thru/or claim 27, and a lens array for carrying out incidence of two or more flux of lights to said polarizing element.
[Claim 39] Said lens array is the polarization conversion unit of claim 38 characterized by consisting of a cylindrical-lens array or a fly eye lens.
[Claim 40] Image equipment characterized by modulating the polarization light from the polarizing element of either claim 30 thru/or claim 37, either polarization conversion unit of claim 38 and claim 39 and said polarizing element, or said polarization conversion unit, and having a generating bundle ****** generator for image light.
[Claim 41] Image projection equipment characterized by having the projection system which modulates the polarization light from the polarizing element of either claim 30 thru/or claim 37, either polarization conversion unit of claim 38 and claim 39 and said polarizing element, or said polarization conversion unit, and projects said image light from a generating bundle ****** generator and this image generator for image light.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0011
[Method of Amendment] Modification
[Proposed Amendment]
[0011] Moreover, the illumination-light study system from which the image projection equipment of this invention changes into polarization light the unpolarized light light from the light source which emits unpolarized light light, and this light source, In equipment equipped with the image generator made to generate an image by modulating this polarization light according to a video signal, and the projection optics which projects this image The conversion system from which said illumination-light study system changes said unpolarized light light into an optical grid-like pattern, It has the polarizing element installed to the optical axis of this conversion system so it might make this grid-like light pattern change into polarization light almost densely. It has the transparence parallel plate with which this polarizing element equipped one field with the polarization demarcation membrane. It reflects in the reflector which prepared one light of the grid-like reflected light produced in this polarization demarcation membrane, and the grid-like transmitted light in the field of another side of a transparence parallel plate, and towards an optical path almost parallel to the optical path of the light of another side, the plane of polarization of one [at least] light of this grid-like reflected light and the grid-like transmitted light is changed, and the plane of polarization of both light is made in agreement. It has the transparence plate with which the polarizing element by other gestalten of this invention formed the polarization demarcation membrane in one field, and formed the reflective film in the field of another side. It returns to said polarization demarcation membrane by reflecting the transmitted light of the reflected lights and

the transmitted lights which were separated by the polarization demarcation membrane of one [said] field by the reflective film of the field of said another side. It is characterized by making both polarization directions in agreement by changing one [at least] polarization direction of said transmitted light and reflected light. The polarization conversion unit by other gestalten of this invention has the above-mentioned polarizing element and a lens array for carrying out incidence of two or more flux of lights to said polarizing element. The image equipment by this invention is characterized by modulating the polarization light from a polarizing element, above-mentioned polarization conversion unit and polarizing element, or an above-mentioned polarization conversion unit, and having a generating bundle ****** generator for image light. The image projection equipment by other gestalten of this invention is characterized by having the projection system which modulates the polarization light from a polarizing element, above-mentioned polarization conversion unit and polarizing element, or an above-mentioned polarization conversion unit, and projects said image light from a generating bundle ****** generator and this image generator for image light.

[Procedure amendment 4]

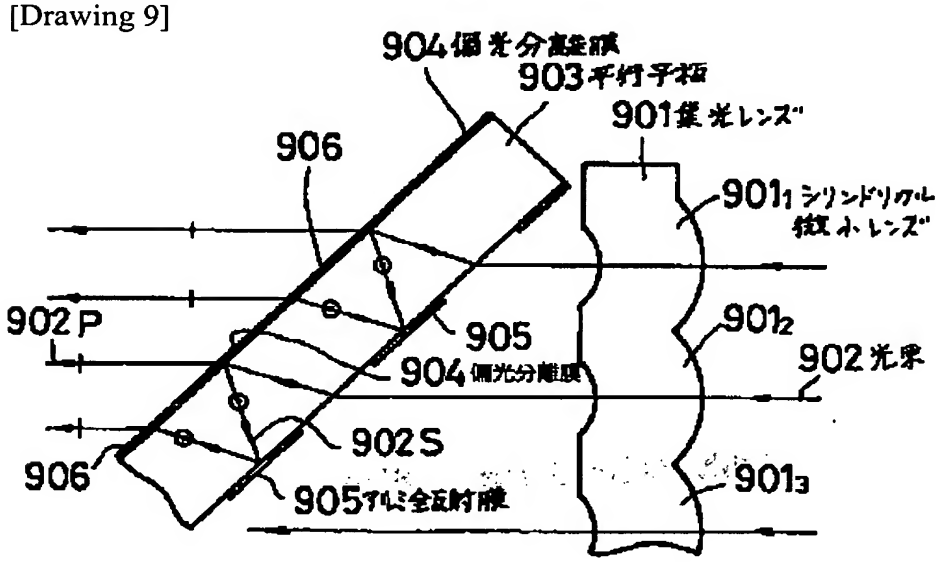
[Document to be Amended] DRAWINGS

[Item(s) to be Amended] drawing 9

[Method of Amendment] Modification

[Proposed Amendment]

[Drawing 9]



[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号

特開平5－107505

(43)公開日　平成５年(1993)４月30日

(51)Int.Cl.[5]		識別記号	庁内整理番号	ＦＩ	技術表示箇所
Ｇ０２Ｂ	27/28		Ｚ　9120－2Ｋ		
	5/30		7724－2Ｋ		
Ｇ０２Ｆ	1/13	５０５	8806－2Ｋ		
	1/1335	５１０	7724－2Ｋ		
	1/1347		7348－2Ｋ		

審査請求　未請求　請求項の数27(全 15 頁)　最終頁に続く

(21)出願番号　特願平4－87211

(22)出願日　平成４年(1992)４月８日

(31)優先権主張番号　特願平3－103317

(32)優先日　平３(1991)４月９日

(33)優先権主張国　日本（ＪＰ）

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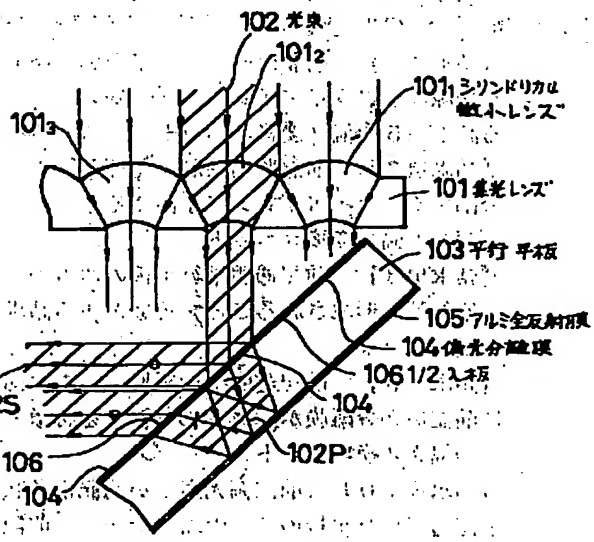
(54)【発明の名称】板状偏光素子、該素子を備える偏光変換ユニット、および該ユニットを備える画像投影装置

(57)【要約】

【目的】入射光を効率よく用いることができ、低コストかつ小型の画像投影装置を実現することのできる偏光素子を実現すること。

【構成】透明平行平板の一方の面に、該一方の面又は他方の面側から該平行平板に入射する入射光を反射光及び透過光に分割する偏光分離膜を備え、該反射光及び透過光の一方の光を該透明平行平板の前記他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該反射光及び透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させる。



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【特許請求の範囲】

【請求項１】　透明平行平板の一方の面に、該一方の面又は他方の面側から該平行平板に入射する入射光を反射光及び透過光に分割する偏光分離膜を備え、該反射光及び透過光の一方の光を該透明平行平板の前記他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該反射光及び透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする板状偏光素子。

【請求項２】　前記反射光及び透過光の一方の光の偏光面を変化させ他方の光の偏光面と一致させるべく前記透明平行平板の前記一方の面の所定箇所に１／２λ膜が形成されることを特徴とする請求項１の板状偏光素子。

【請求項３】　前記反射光及び透過光の一方の光の偏光面を変化させ他方の光の偏光面と一致させるべく前記透明平行平板の前記一方の面の近傍に１／２λ板が配されることを特徴とする請求項１の板状偏光素子。

【請求項４】　前記反射光及び透過光の一方の光の偏光面を変化させ他方の光の偏光面と一致させるべく前記透明平行平板の前記一方または他方の面に１／４λ膜が形成されることを特徴とする請求項１の板状偏光素子。

【請求項５】　格子状の非偏光光を供給する照明系と、該非偏光光をほぼ稠密な偏光光に変換せしめるべく該照明系の光軸に対して斜設した偏光素子とを備え、該偏光素子が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする偏光変換ユニット。

【請求項６】　前記照明系が、多数個の発光素子を並べた光源部とフライアイレンズとを備えることを特徴とする請求項５の偏光変換ユニット。

【請求項７】　前記照明系が、光源からの光を複数個に分割するフライアイレンズを備えることを特徴とする請求項５の偏光変換ユニット。

【請求項８】　前記透明平行平板の他方の面のほぼ全面に反射膜が形成されることを特徴とする請求項５の偏光変換ユニット。

【請求項９】　前記透明平行平板の一方の面のほぼ全面に前記偏光分離膜が形成されることを特徴とする請求項５の偏光変換ユニット。

【請求項１０】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の一方の面で受光し、前記偏光分離膜から前記格子状透過光を前記透明平行平板の他方の面に向けるようにし、前記偏光分離膜上に、前記透明平行平板の他方の面で反射した前記格子状透過光の偏光面を変化させ前記格子状反射光の偏光面と一致させるべく、１／２λ板を格子状に形成することを特徴とする請求項９

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の偏光変換ユニット。

【請求項１１】　前記透明平行平板の他方の面のほぼ全面に反射膜が形成されることを特徴とする請求項１０の偏光変換ユニット。

【請求項１２】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の一方の面で受光し、前記偏光分離膜から前記格子状透過光を前記透明平行平板の他方の面に向けるようにし、前記格子状透過光を前記透明平行平板の他方の面で反射させると共に前記格子状反射光の偏光面と一致させるべく前記透明平行平板の他方の面のほぼ全面に１／４λ板と反射膜とを形成することを特徴とする請求項５の偏光変換ユニット。

【請求項１３】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の一方の面で受光し、前記偏光分離膜を格子状に形成し前記偏光分離膜から前記格子状透過光を前記透明平行平板の他方の面に向けるようにし、前記透明平行平板の一方の面に前記透明平行平板の他方の面で反射した前記格子状反射光の偏光面を前記格子状透過光の偏光面と一致させるべく、１／２λ膜を前記偏光分離膜と交互に格子状に形成することを特徴とする請求項５の偏光変換ユニット。

【請求項１４】　非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記照明光学系が、前記非偏光光を格子状の光パターンに変換する変換系と、該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項１５】　非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記非偏光光をＲＧＢの３色の非偏光光に分解する色分解系を有し、該色分解系が該ＲＧＢの３色の非偏光光の各光路に非偏光光を格子状の光パターンに変換する変換系と該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、一方の面に偏光分離膜を設けた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他

方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項１６】　非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記非偏光光をＲＧＢの３色の非偏光光に分解する色分解系を有し、該色分解系が該ＲＧＢの内の２色の非偏光光の共通光路と他の一色の非偏光光の光路の夫々に非偏光光を格子状の光パターンに変換する変換系と該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項１７】　透明平行平板の一方の面に、該平行平板の他方の面側から該平行平板に入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設けることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする板状偏光素子。

【請求項１８】　該偏光面回転手段が、該平行平板のいずれか一方の面に設けられた１／４λ膜であることを特徴とする請求項１７の板状偏光素子。

【請求項１９】　該偏光面回転手段が、旋光性物質であることを特徴とする請求項１７の板状偏光素子。

【請求項２０】　該平行平板を旋光性物質で構成し、前記偏光面回転手段としたことを特徴とする請求項１７の板状偏光素子。

【請求項２１】　ストライプ状の光束を供給する照明系と、該光束をほぼ稠密な偏光光に変換せしめるべく該照明系の光軸に対して斜設した偏光素子とを備え、該偏光素子が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする板状偏光素子ユニット。

【請求項２２】　前記照明系が、多数個の発光素子を並べた光源部とシリンドリカルレンズとを備えることを特徴とする請求項５又は２１の偏光変換ユニット。

【請求項２３】　前記照明系が、光源からの光を複数個に分割するシリンドリカルレンズを備えることを特徴とする請求項５又は２１の偏光変換ユニット。

【請求項２４】　光源と、該光源からの光束を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記照明光学系が、前記光源からの光束をストライプ状に変換する変換系と、該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項２５】　光源と、該光源からの光束を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記光束をＲＧＢの３色の光束に分離する色分解系を有し、該色分解系が該ＲＧＢの３色の光束の各光路に光束をストライプ状の光パターンに変換する変換系と該ストライプ状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項２６】　光源と、該光源からの光束を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、

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前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記光束をＲＧＢの３色の光束に分離する色分解系を有し、該色分解系が該ＲＧＢの内の２色の光束の共通光路と他の一色の光束の光路の夫々に光束をストライプ状の光パターンに変換する変換系と該ストライプ状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項２７】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の前記他方の面で受光し、前記一方の面の偏光分離膜で前記格子状透過光と前記格子状反射光とに分離し、前記格子状反射光を前記透明平行平板の前記他方の面に向けるようにし、前記一方の面上に、前記透明平行平板の他方の面で反射した前記格子状反射光の偏光面を変化させ前記格子状透過光の偏光面と一致させるべく、１／２λ板を格子状に形成することを特徴とする請求項９に記載の偏光変換ユニット。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、入射された種々な偏光方向成分を持つ光を、偏光方向を揃えて出射する偏光素子に関する。

【０００２】

【従来の技術】従来より図１７に示すような構成の画像投影装置が知られている。

【０００３】光源1550に発生した光束をダイクロイックミラー1551，1552でＲ，Ｇ，Ｂに分離し、全反射ミラー1553も使用して液晶ライトバルブ1554，1555，1556へ導き、さらに全反射ミラー1557で光路を曲げ、ダイクロイックミラー1558，1559でＲ，Ｇ，Ｂの３つの像の合成を行ない、投射レンズ1560で図示していないスクリーン上に投射する投射光学系である。

【０００４】このような画像投影装置においては、液晶ライトバルブ1554，1555，1556は液晶板を偏光素子である２枚の偏光板を挟んだ形態とし、種々な偏光方向を持つ自然光が入射側の偏光板に入射されると、１つの偏光方向以外の偏光は該入射側の偏光板で吸収され、液晶板には1つの偏光成分の光のみが入射される構成がとられる。

【０００５】一方、特開昭61－90584号公報に記載されたものにおいては、入射側の偏光板を廃し、その代わりにプリズムと偏光素子であるビームスプリッタとを用いて偏光方向を一方向に揃えて液晶板に入射させる構成がとられている。

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【０００６】

【発明が解決しようとする課題】図１７に示したものにおいては、入射側の偏光板で、該偏光板の偏光方向以外の光が吸収されてしまうために投射画面が暗くなるという問題点があり、さらに、吸収された光によって液晶板の温度が上昇し、液晶板の劣化を招いてしまうという問題点がある。

【０００７】一方、特開昭61－90584号公報に記載されたものにおいては、偏光ビームスプリッタとプリズムを使用しているために、装置が大型化するうえに、プリズムの研磨に手間とコストがかかるという問題点があった。プリズムのようにガラスブロックを用いているものは重くなりすぎて、画像投影装置としてのポータビリティが悪くなる。

【０００８】本発明は上述した各従来技術が有する問題点に鑑みてなされたものであって、入射光を効率よく用いることができ、低コストかつ小型の画像投影装置を実現することのできる偏光素子を実現することを目的とする。

【０００９】

【課題を解決するための手段】本発明の板状偏光素子は、透明平行平板の一方の面に、該一方の面又は他方の面側から該平行平板に入射する入射光を反射光及び透過光に分割する偏光分離膜を備え、該反射光及び透過光の一方の光を該透明平行平板の前記他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該反射光及び透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させる。

【００１０】また、本発明の偏光変換ユニットは、格子状の非偏光光を供給する照明系と、該非偏光光をほぼ稠密な偏光光に変換せしめるべく該照明系の光軸に対して斜設した偏光素子とを備え、該偏光素子が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させる。

【００１１】また、本発明の画像投影装置は、非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記照明光学系が、前記非偏光光を格子状の光パターンに変換する変換系と、該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子が、一方の面に偏光分離

膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させる。

【００１２】

【作用】平行平板の一方の面に設けられた偏光分離膜によって反射された光と、偏光分離膜を透過して平行平板の他方の面にて上記偏光分離膜による反射光とほぼ平行な光路に反射される光のいずれかの偏光面が双方が一致するように変化させるので、偏光分離膜によって反射された光と、該偏光分離膜を透過した光の偏光面および進行方向は揃ったものとなる。

【００１３】

【実施例】図１は本発明の偏光素子の第１の実施例の構成を示す図である。

【００１４】本実施例は、シリンドリカル微小レンズ$10 1_1$, 101_2, 101_3から構成される樹脂成形品であり、入射光を格子状の非偏光光として出射する照明系である集光レンズ101と、該集光レンズ101の光軸に対して４５度の角度で設けられた透明な光学材料による平行平板103とで構成されている。該シリンドリカル微小レンズ101_1, 101_2, 101_3のそれぞれは入射側の面が正のパワーを、出射側の面が負のパワーを有し、負のパワーが正のパワーの２倍の大きさを持ち、平行光である入射光が、その１／２の幅の平行光となって出射されるアフォーカルコンバーターの機能を持っている。

【００１５】平行平板103の集光レンズ101側の面には、多層膜で構成される偏光分離膜104と膜状の１／２λ板（１／２波長膜）106のペアが、４５度方向から見た各シリンドリカル微小レンズ101_1～101_3のピッチでありかつそれぞれの幅が各シリンドリカル微小レンズ101_1～101_3で集光された光束の幅と略同一の幅となるようにストライプ状に設けられている。平行平板103の反集光レンズ101側の面には高反射処理を施したアルミ全反射膜105が全面に設けられている。

【００１６】集光レンズ101に入射する光束102を略平行光とすると、該光束102は集光レンズ101の各シリンドリカル微小レンズ101_1～101_3で１／２の幅の格子状の平行光に圧縮され、平行平板103の集光レンズ101側の面に設けられた偏光分離膜104で以下のように分離される。

【００１７】Ｓ偏光102Sは入射光に対して直交する方向に反射され、Ｐ偏光102Pは透過する。透過したＰ偏光102Pは平行平板103の反入射側の面に設けられたアルミ全反射膜105で反射され、この後、１／２λ板106を通ることによって偏光方向が９０度回転し、Ｓ偏光となって出射する。このように出射された自然光はS偏光に揃えられる。尚、アルミ全反射膜105を形成せずに、平行平板103の反入射側の面を全反射面に設定し、この面でＰ偏光を反射させてもよい。

【００１８】図２は上記のように構成された偏光素子が組込まれた画像投影装置の構成を示す図である。

【００１９】光源250が発生する種々な偏光方向を持つ平行光束は、図１に示した偏光素子によってＳ偏光のみに変換され、出射される。

【００２０】本実施例におけるダイクロイックミラー251, 252, 258, 259、全反射ミラー253, 257、液晶ライトバルブ254, 255, 256および投射レンズ260のそれぞれは図１７に示したダイクロイックミラー1551, 1552, 1558, 1559、全反射ミラー1553, 1557、液晶ライトバルブ1554, 1555, 1556および投射レンズ1560と同様に構成されている。

【００２１】液晶ライトバルブ254, 255, 256のそれぞれは、ＲＧＢの各色の画像を発生させる３個の発生器から構成される画像発生器（不図示）より入力されるビデオ信号に応じて内蔵する複数の液晶素子を変調することにより画像を発生させる。ダイクロイックミラー251, 252, 258, 259のそれぞれは、図１に示した偏光素子によってＳ偏光のみに変換された照明光をＲＧＢの３色の非偏光光に分解する色分解系を構成するものである。

【００２２】上記の構成とすることにより、各液晶ライトバルブ254, 255, 256での光量ロスが無くなるので投射画像を明るくでき、光の吸収によって熱の発生も生じなくなる。この場合、液晶ライトバルブの入射側の偏光板を設ける必要もなくなり、このように構成してもよい。

【００２３】ここで、偏光素子の入射面を紙面と垂直な面になる様にし、紙面と垂直な方向に光源250が配置される様にすれば各ダイクロイックミラーに対しP偏光が入射する形にすることができるので色分解一合成が効率よくできる。

【００２４】図３は本発明の第２の実施例の構成を示す図である。

【００２５】本実施例は、集光レンズ101の光軸に対して４５度の角度で設けられた平行平板103の集光レンズ側の面に、多層膜で構成される偏光分離膜304を全面に設け、該偏光分離膜上に膜状の１／２λ板306を４５度方向から見た略シリンドリカル微小レンズ101_1～101_3のピッチで、かつ、各シリンドリカル微小レンズで集光された光束の幅と略同一の幅で設けている。この他の構成は図１に示した第１の実施例と同様であるため同一の番号を付して説明は省略する。

【００２６】上記の様な構成にすることにより、偏光分離膜を蒸着するときにマスキングする必要は無く、制作工程をさらに単純化することができる。

【００２７】図４は本発明の第３の実施例の構成を示す図である。

【００２８】本実施例は、第２の実施例において、偏光分離膜304上に直接形成されていた膜状の１／２λ板406を、保持用平行平板409上に形成したうえで、該保持用

平行平板409を偏光分離膜304を介して平行平板103に接合したものである。また、反集光レンズ101側の面の全面に設けられていたアルミ全反射膜305は、４５度方向から見て略シリンドリカル微小レンズ101_1～101_3のピッチで、かつ、それぞれの幅は各シリンドリカル微小レンズで集光された光束の幅と略同一の幅で設けられたアルミ全反射膜405として迷光が正規光の出射方向へ反射しないものとし、さらに、平行平板103の反集光レンズ101側の全面を覆う吸収塗料411を設けて迷光カットの効果をあげている。又、平行平板103上に１／２λ板406を格子状に、保持用平板409上に偏光分離膜304を格子状に、互いの位相が反転するように形成し、互いに接合してもよい。又、１／２λ板406と偏光分離膜304の双方を保持用平行板409上に形成し、平行平板103と保持用平行板409とを貼り合わせてもよい。

【００２９】図５は本発明の第４の実施例の構成を示す図である。

【００３０】本実施例は、平行平板103の全面に偏光回転手段を設けたものである。本実施例では、集光レンズ101の光軸に対して４５度の角度で設けられた平行平板103の集光レンズ101側の面には、多層膜で構成された偏光分離膜504が４５度方向から見てシリンドリカル微小レンズ101_1～101_3のピッチで、かつ、各シリンドリカル微小レンズで集光された光束の幅と略同一の幅で設けられている。一方、平行平板103の反集光レンズ101側の面には、膜状の１／４λ板506が全面に設けられ、さらに、アルミ全反射膜505が全面に蒸着された保持用平行平板510がアルミ全反射膜505と１／４λ板506とが対向するように設けられている。

【００３１】上記のような構成とすることにより、膜状の１／４λ板506を全面に付ければ良いので制作工程を単純化することができる。

【００３２】偏光変換素子に入射する光束102を略平行光とすると、集光レンズ101を構成する各シリンドリカル微小レンズ101_1～101_3で光束幅が圧縮され、平行平板103の集光レンズ101側の面に設けられた偏光分離膜504によってＳ偏光102Sは反射され、Ｐ偏光102Pは透過する。透過したＰ偏光102Pは、平行平板103の反入射レンズ101側の面に設けられた１／４λ板506を通過することにより円偏光となり、アルミ全反射膜505で反射された後に再び１／４λ板506を通過することにより偏光方向が９０度回転したＳ偏光となって偏光分離膜504の間から出射する。　上記のようにして入射した自然光をＳ偏光に揃えることができる。

【００３３】図６は本発明の第５の実施例の構成を示す図である。

【００３４】本実施例は、図５に示した第４の実施例と同様に、偏光回転手段を平行平板103の全面に設けたものである。

【００３５】本実施例では、集光レンズ101の光軸に対して４５度の角度で設けられた平行平板103の集光レンズ101側の面には膜状の１／４λ板606が全面に設けられている。該１／４λ板606上には、偏光分離膜604が、４５度方向から見たシリンドリカル微小レンズ101_1～101_3のピッチで、かつ各シリンドリカル微小レンズで集光された光束の幅と略同一の幅で設けられ、一方、平行平板103の反集光レンズ101側の面にはアルミ全反射膜605が全面に蒸着されている。

【００３６】上記のように、膜状の１／４λ板606を全面に付ける構成とすることにより、制作工程を単純化することができる。

【００３７】偏光素子に入射する光束102は集光レンズ101を構成する各シリンドリカル微小レンズ101_1～101_3で光束幅が圧縮され、平行平板103の集光レンズ101側の面に設けられた偏光分離膜604によってＳ偏光102Sは入射光に対して直交する方向に反射され、Ｐ偏光102Pは透過する。透過したＰ偏光102Pは、１／４λ板606を通過することにより円偏光となり、平行平板103の反集光レンズ101側の面に設けられたアルミ全反射膜605で反射された後に、再び１／４λ板606を通過することにより偏光方向が９０度回転されたＳ偏光となって偏光分離膜604の間から出射する。

【００３８】上記のようにして入射した自然光をＳ偏光に揃えることができる。

【００３９】なお、本実施例では平行光から外れた照明光が迷光とならないように、平行平板103の集光レンズ101側の部分に上記平行光から外れた照明光を遮り、出射光は通すように遮光板612を出射光と略平行に設けて出射光の偏光の純度を向上している。

【００４０】図７は本発明の第６の実施例の構成を示す図である。

【００４１】本実施例は、平行平板に微小プリズムを組み合わせたものである。

【００４２】集光レンズ101の光軸に対して４５度の角度で設けられた平行平板103の集光レンズ101側の面には、多層膜で構成された偏光分離膜704と膜状の１／２λ板706のペアが、４５度方向から見たシリンドリカル微小レンズ101_1～101_3のピッチで、かつそれぞれの幅は各シリンドリカル微小レンズで集光された光束の幅と略同一の幅で設けられ、平行平板103の反集光レンズ101側の面にはアルミ全反射膜705が全面に設けられている。さらに、平行平板103の集光レンズ101側の面には、集光レンズ101の光軸に対して略垂直の平面および出射光に対して略垂直の平面を持つ微小プリズム708_1～708_5からなるプリズム板708が平行平板103に接合して設けられている。

【００４３】偏光素子に入射する光束102を略平行光とすると、集光レンズ101を構成するシリンドリカル微小レンズ101_1～101_3で光束幅が圧縮され、プリズム板708を構成する微小プリズム708_1～708_5に入射し、平行平板

103の集光レンズ101側の面に設けられた偏光分離膜704でS偏光102SとP偏光102Pに分離される。S偏光102Sは、入射光102に対して直交する方向に反射してプリズム板708を構成する各微小プリズム708_1，708_3，708_5等と通って出射する。P偏光102Pは偏光分離膜704を透過し、平行平板103の反集光レンズ101側の面に設けられたアルミ全反射膜705で反射され、1／2λ板706を通過することにより、偏光方向が90度回転されたS偏光となり、さらにプリズム板708を構成する微小プリズム708_2，708_4等と通って出射する。

【0044】上記のようにして入射した自然光をS偏光に揃えることができる。

【0045】本実施例のように、偏光分離膜を光学媒質中に設ける構成とすると、広帯域に亙って消光比を高くすることができる。

【0046】図8は本発明の第7の実施例の構成を示す図である。

【0047】本実施例は、図7に示した第6の実施例と同様に、平行平板に微小プリズムを組み合わせたものである。

【0048】集光レンズ101の光軸に対して45度の角度で設けられた平行平板103の集光レンズ101側の面には多層膜で構成された偏光分離膜804が全面に設けられており、反集光レンズ101側の面にはアルミ全反射膜805が全面に設けられている。さらに平行平板103の集光レンズ101側の面には、集光レンズ101の光軸に対して略垂直の平面および出射光に対して略垂直の平面を持つ微小プリズム808_1～808_5からなるプリズム板808が平行平板103に接合して設けられている。

【0049】プリズム板808を構成する微小プリズム808_1～808_5のうち、各シリンドリカル微小レンズの中間に位置する微小プリズム808_2，808_4等の各出射部には、それぞれ膜状の1／2λ板806が設けられ、出射部と垂直の面には、それぞれ遮光部材812が設けられている。

【0050】上記のような構成とすることにより、図7に示した第6の実施例と同様に入射した自然光をS偏光に揃えることができ、さらに、遮光部材812を設けたことにより迷光を除去することができ、消光比を高いものとすることができた。

【0051】図9は本発明の第8の実施例の構成を示す図であり、透過型の偏光素子に適用したものである。

【0052】本実施例の偏光素子は、アフォーカルコンバーターの機能を有するシリンドリカル微小レンズ901_1～901_3より構成される樹脂成形品の集光レンズ901と、該集光レンズ901の光軸に対して平面部が45度の角度を有するように配置された平行平板903とから構成されている。平行平板903の反集光レンズ901側の面には多層膜で構成された偏光分離膜904と膜状の1／2λ板906のペアが、45度方向から見たシリンドリカル微小レンズ901_1～901_3のピッチであり、かつ、それぞれの幅は各シリンドリカル微小レンズで集光された光束も幅と略同一の幅で設けられており、平行平板903の集光レンズ901側の面にはアルミ全反射膜905が、45度方向から見たシリンドリカル微小レンズ901_1～901_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるように設けられている。

【0053】偏光素子に入射した光束902を略平行光とすると、光束902は集光レンズ901を構成するシリンドリカル微小レンズ901_1～901_3によって光束幅が圧縮され、平行平板903の集光レンズ901側に設けられたアルミ全反射膜905の間を通って平行平板903の反集光レンズ901側の面に設けられた偏光分離膜904に入射する。偏光分離膜904に入射した光束902はP偏光902PとS偏光902Sとに分離される。P偏光902Pは偏光分離膜902を透過し出射される。一方、S偏光902Sは反射して平行平板903の集光レンズ901側に設けられた高反射アルミ全反射膜905で反射され、平行平板903の反集光レンズ901側に設けられた1／2λ板906を通って出射される。該1／2λ板906を通ることにより、偏光方向が90度回転されてP偏光として出射される。

【0054】上記のようにして、入射した自然光をP偏光に揃えることができる。

【0055】図10は本発明の第9の実施例の構成を示す図であり、図9に示した第8の実施例と同様に透過型の偏光素子に適用したものである。

【0056】本実施例は、平行平板903の反集光レンズ901側に膜状の1／2λ板1006を45度方向から見たシリンドリカル微小レンズ901_1～901_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるように設け、同じく平行平板903の反集光レンズ901側の全面に多層膜で構成された偏光分離膜104を設けた。一方、平行平板903の集光レンズ901側の面には、アルミ（あるいは銀）の全反射膜1005が、45度方向から見たシリンドリカル微小レンズ901_1～901_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるように設けられている。この他の構成は図9に示した第8の実施例と同様であるため同じ番号を付して説明は省略する。

【0057】上記のような構成とすることにより、図9に示した第8の実施例と同様に入射した自然光をP偏光に揃えることができる。また、本実施例のものにおいては、偏光分離膜が全面に設けられているので、これを形成するときにマスクする必要が無く、製造工程を単純化することができる。また、偏光分離膜が全面に設けられているため、入射光はすべて偏光分離膜を介して出射光となるので、出射光の偏光比がさらによくなるという効果も有する。

【0058】図11は本発明の第10の実施例の構成を

示す図であり、図９および図１０に示した第８および第９の実施例と同様に透過型の偏光素子に適用したものである。

【００５９】本実施例は、平行平板903の反集光レンズ901側の面に、偏光分離膜1104を４５度方向から見たシリンドリカル微小レンズ901_1～901_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるように設け、一方、平行平板903の集光レンズ901側の面には、膜状の１／４λ板1106を設け、さらに１／４λ板1106上にアルミ（あるいは銀）の全反射膜1105を４５度方向から見たシリンドリカル微小レンズ901_1～901_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるように設けたものである。また、反集光レンズ901側の偏光分離膜1104の両側には不要光を吸収除去するための吸収部材1116が設けられている。この他の構成は図９および図１０にそれぞれ示した第８および第９の実施例都同様であるため同じ番号を付して説明は省略する。

【００６０】上記のような構成とすることにより、膜状の１／４λ板1106は全面に設ければよいため、製造工程を単純化することができる。

【００６１】図１２は本発明の第１１の実施例の構成を示す図である。

【００６２】本実施例においては、集光レンズ1301はシリンドリカル微小レンズ1301_1～1301_3によって構成され、平行平板903は集光レンズ1301の光軸に対して４５度の角度で設けられている。平行平板903の反集光レンズ1301側の面には、１／２λ板1306が設けられ、その上に、多層膜で構成された偏光分離膜1304が全面に設けられている。また、平行平板903の集光レンズ1301側の面には高反射処理が施されたアルミ全反射膜1305が設けられている。これらの１／２λ板1306およびアルミ全反射膜1305のいずれも４５度方向から見たシリンドリカル微小レンズ1301_1～1301_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるように設けられている。これらの偏光分離膜1304およびアルミ全反射膜1305の上部には平行平板903を全面にわたって覆う出射側プリズム板1307および入射側プリズム板1308がそれぞれ設けられている。出射側プリズム板1307は微小プリズム1307_1～1307_5から構成され、入射側プリズム板1308は微小プリズム1308_1～1308_3から構成されている。これらの微小プリズム1307_1～1307_5、1308_1～1308_3のいずれも集光レンズ1301の光軸に対して垂直な平面（出射部）と平行な平面とを有するもので、各シリンドリカル微小レンズに対して、出射側プリズム板1307を構成する微小プリズムは２個ずつ設けられ、入射側プリズム板1308を構成する微小プリズムは１個ずつ設けられている。集光レンズ1301を構成するシリンドリカル微小レンズ1301_1～1301_3は平行光から外れた光が損失光となることを防ぐために、各シリンドリカル微小レンズ1301_1～1301_3は段差をもって配設され、それぞれに対応する微小プリズム1308_1～1308_3に近接するように構成されている。

【００６３】上記のように構成された偏光素子に入射する光束902を平行光束とすると、光束902は集光レンズ1301を構成するシリンドリカル微小レンズ1301_1～1301_3によって１／２の幅に圧縮されて入射側プリズム板1308を構成する微小プリズム1308_1～1308_3に入射し、平行平板903の集光レンズ1301側の面に設けられたアルミ全反射膜1305の隙間を通った後に平行平板903の反集光レンズ1301側の面に設けられた偏光分離膜1304によってＰ偏光902PとＳ偏光902Sとに分離される。Ｐ偏光902Pは該偏光分離膜1304を透過し、出射側プリズム板1307を構成する微小プリズム1307_1、1307_3等を通って出射する。一方、Ｓ偏光902Sは、入射光に直交する方向に反射され、平行平板903の集光レンズ1301側の面に設けられたアルミ全反射膜1305で反射された後に１／２λ板1306、偏光光分離膜1304、出射側プリズム板1307を構成する微小プリズム1307_2、1307_4等を順に通って出射される。該１／２λ板1306を通る際に偏光方向が９０度回転してＰ偏光となるため、出射光はすべてＰ偏光となる。

【００６４】上記のようにして、入射した自然光をＰ偏光に揃えることができる。また、本実施例もさらに偏光比がよくなるという効果を有する。

【００６５】図１３は本発明の第１２の実施例の構成を示す図である。

【００６６】本実施例は図１２に示した実施例と同様の構成を有する変換ユニット1401_1～1401_3を用い、これら複数のユニットの各端部を揃え、かつ平行に設置して省スペースを図ったものである。

【００６７】このような構成とすることにより、偏光変換素子の占有体積、特に集光レンズの光軸方向の寸法を小さくすることができる。例えば図示するような３個のユニットに分割することにより、集光レンズの光軸方向の寸法を約１／３とすることができ、これを用いて構成される画像投影装置装置の小型化に寄与することができる。

【００６８】なお、各実施例におい偏光回転手段として１／２λ板を用いるものとして説明したが、この他にも１／４λ板を２回通る構成や、液晶板等の旋光製物質やファラデーセル等の偏光面回転装置を用いて偏光方向を回転させるものとしてもよい。

【００６９】また、照明系についてはシリンドリカル微小レンズから構成される集光レンズとして説明したが、該照明系が、多数個の発光素子を並べた光源部と、光源部にて発生した光を平均化する、もしくは複数個に分割するフライアイレンズとを備えるものとしてもよい。

【００７０】また、集光レンズを構成するシリンドリカル微小レンズの光学面についてはとくに述べなかった

が、非球面とすることにより集光性能を上げることができ、香料の損失およびフレア光の発生を大幅に減少させることができる。

【００７１】集光部材について言えば、集光部材はプリズムで構成されてもよい。また、集光部材を回転対象のレンズとし、市松模様状に配列してもよい。この場合、全反射ミラー、偏光分離膜、偏光回転手段（１／２λ板等）のうち、離散的に配列されるものについては上記集光部材の配列状態に応じて配列されるものとすればよい。

【００７２】また、図３～図１３に示した各偏光ユニットによる画像投影装置は、上記各効果を備えたものとなる。

【００７３】図１４は本発明の第１３の実施例の構成を示す図である。

【００７４】本実施例の偏光素子は、アフォーカルコンバーターの機能を有するシリンドリカル微小レンズ2901_1～2901_3より構成される樹脂成形品の集光レンズ2901と、該集光レンズ2901と光軸に対して平面部が４５度の角度を有するように配置された平行平板2903とから構成されている。該シリンドリカル微小レンズ2901_1，2901_2，2901_3のそれぞれは入射側の面が正のパワーを、出射側の面が負のパワーを有し、負のパワーが正のパワーの２倍の大きさを持ち、平行光である入射光が、その１／２の幅の平行光となって出射されるアフォーカルコンバーターの機能を持っている。平行平板2903の集光レンズ2901側の面には高反射処理をされたアルミ全反射膜2905が、４５度方向から見たシリンドリカル微小レンズ2901_1～2901_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるようにストライプ状に設けられている。平行平板2903の反集光レンズ2901側の面には略全面に膜状の１／４λ板2906を設け、さらに１／４λ板2906上に多層膜で構成された偏光分離膜2904がやはり略全面に設けられている。

【００７５】偏光素子に入射した光束2902を略平行光とすると、光束2902は集光レンズ2901を構成するシリンドリカル微小レンズ2901_1～2901_3によって光束幅が圧縮分離され、平行平板2903の集光レンズ2901側にストライプ状に設けられたアルミ全反射膜2905の間を通って平行平板2903の反集光レンズ2901側の面に設けられた１／４λ板2906を透過した後偏光分離膜2904に入射する。偏光分離膜2904に入射した光束2902はＰ偏光2902PとＳ偏光2902Sとに分離される。Ｐ偏光2902Pは偏光分離膜2904を透過し出射される。一方、Ｓ偏光2902Sは反射して平行平板2903の反集光レンズ2901側に設けられた１／４λ板2906を通って円偏光に変換された後に平行平板2903の集光レンズ2901側に設けられた高反射アルミ全反射膜2905で反射され、さらに平行平板2903の反集光レンズ2901側に設けられた１／４λ板2906を通って出射される。該１／４λ板2906を往復で通る時に、偏光方向が９０度回転されてＰ偏光として出射される。

【００７６】このようにして、入射した自然光をＰ偏光に揃えることができる。

【００７７】上記のような構成とすることにより、パターン形成の困難な偏光分離膜2904及び膜状の１／４λ板2906は全面に設ければよいため、製造工程を単純化することができる。アルミ全反射膜2905をストライプ状に蒸着して設けることは容易である。

【００７８】図１５は上記のように構成された偏光素子が組込まれた画像投影装置の構成を示す図である。

【００７９】光源2250が発生する種々な偏光方向を持つ平行光束は、図１４に示した偏光素子によってＰ偏光のみに変換され、出射される。

【００８０】本実施例におけるダイクロイックミラー2251，2252，2258，2259、全反射ミラー2253，2257、液晶ライトバルブ2254，2255，2256および投影レンズ2260のそれぞれは図１７に示したダイクロイックミラー1551，1552，1558，1559、全反射ミラー1553，1557、液晶ライトバルブ1554，1555，1556および投射レンズ1560と同様に構成されている。

【００８１】液晶ライトバルブ2254，2255，2256のそれぞれは、ＲＧＢの各色の画像を発生させる３個の発生器から構成される画像発生器（不図示）より入力されるビデオ信号に応じて内蔵する複数の液晶素子を変調することにより画像を発生させる。ダイクロイックミラー2251，2252，2258，2259のそれぞれは、図１４に示した偏光素子によってＰ偏光のみに変換された照明光をＲＧＢの３色の光束に分解する色分解系を構成するものである。

【００８２】上記の構成とすることにより、各液晶ライトバルブ2254，2255，2256での光量ロスが無くなるので投射画像を明るくでき、光の吸収によって熱の発生も生じなくなる。この場合、液晶ライトバルブの入射側の偏光板を設ける必要もなくなり、このように構成してもよい。また、この様な構成にすれば各ダイクロイックミラーに対しＰ偏光が入射する形にすることができるので色分解ー合成が効率よくできる。

【００８３】図１６は本発明の第１５の実施例の構成を示す図である。

【００８４】本実施例においては、集光レンズ2301はシリンドリカル微小レンズ2301_1～2301_3によって構成され、平行平板2103は集光レンズ2301の光軸に対して４５度の角度で設けられている。平行平板2103の反集光レンズ2301側の面には、多層膜で構成された偏光分離膜2304が全面に設けられている。平行平板2103は集光レンズ2301側の面には１／４λ板2306が設けられ、１／４λ板2306の上面には高反射処理が施されたアルミ全反射膜2305がストライプ状に設けられている。ストライプ状に設けられているアルミ全反射膜2305は４５度方向から見たシ

リンドリカル微小レンズ2301_1～2301_3のピッチであり、かつ、それぞれの幅が各シリンドリカル微小レンズで集光された光束の幅と略同一の幅となるように設けられている。これらの偏光分離膜2304およびアルミ全反射膜2305の上部には平行平板2103を全面にわたって覆う出射側プリズム板2307および入射側プリズム板2308がそれぞれ設けられている。出射側プリズム板2307は微小プリズム2307_1～2307_5から構成され、入射側プリズム板2308は微小プリズム2308_1～2308_3から構成されている。これらの微小プリズム2307_1～2307_5、2308_1～2308_3のいずれも集光レンズ2301の光軸に対して垂直な平面（出射部）と平行な平面とを有するもので、各シリンドリカル微小レンズに対して、出射側プリズム板2307を構成する微小プリズムは２個ずつ設けられており、入射側プリズム板2308を構成する微小プリズムは１個ずつ設けられている。集光レンズ2301を構成するシリンドリカル微小レンズ2301_1～2301_3は平行光から外れた光が損失光となることを防ぐために、各シリンドリカル微小レンズ2301_1～2301_3は段差をもって配設され、それぞれに対応する微小プリズム2308_1～2308_3に近接するように構成されている。

【００８５】上記のように構成された偏光素子に入射する光束2102を平行光束とすると、光束2102は集光レンズ2301を構成するシリンドリカル微小レンズ2301_1～2301_3によって１／２の幅に圧縮されて入射側プリズム板2308を構成する微小プリズム2308_1～2308_3に入射し、平行平板2103の集光レンズ2301側の面にストライプ状に設けられたアルミ全反射膜2305の隙間を通った後に平行平板2103の反集光レンズ2301側の面に設けられた偏光分離膜2304によってＰ偏光2102Pとｓ偏光2102Sとに分離される。Ｐ偏光2102Pは該偏光分離膜2304を透過し、出射側プリズム板2307を構成する微小プリズム2307_1，2307_3等を通って出射する。一方、Ｓ偏光2102Sは、入射光に直交する方向に反射され、平行平板2103の集光レンズ2301側の面に設けられた１／４λ板2306を透過してアルミ全反射膜2305で反射されるが、さらに１／４λ板2306を透過し、出射側プリズム板2307を構成する微小プリズム2307_2，2307_4等を順に通って出射される。該１／４λ板2306を往復で通る際に偏光方向が９０度回転してＰ偏光となるため、出射光はすべてＰ偏光となる。

【００８６】上記のようにして、入射した自然光をＰ偏光に揃えることができる。

【００８７】なお、各実施例において偏光回転手段として１／４λ板を２回通る構成として説明したが、液晶板等の旋光製物質やファラデーセル等の偏光面回転装置を用いて偏光方向を回転させるものとしてもよい。また、偏光方向回転手段、偏光分離膜、全反射ミラーは平行平板に直接設けなくても別の薄い第２の平行平板に形成して前記平行平板に接着するような構成としても良い。その方が信頼性が高くなる場合がある。

【００８８】また、照明系についてはシリンドリカル微小レンズから構成される集光レンズとして説明したが、該照明系が、多数個の発光素子を並べた光源部と、光源部にて発生した光を平均化する、もしくは複数個に分割するフライアイレンズとを備えるものとしてもよい。

【００８９】また、集光レンズを構成するシリンドリカル微小レンズの光学面についてはとくに述べなかったが、非球面とすることにより集光性能を上げることができ、光量の損失およびフレア光の発生を大幅に減少させることができる。

【００９０】集光部材について言えば、集光部材はプリズムで構成されてもよい。また、集光部材を回転対称のレンズとし、市松模様状に配列してもよい。この場合、全反射ミラーのように離散的に配列されるものについては上記集光部材の配列状態に応じて配列されるものとすればよい。

【００９１】

【発明の効果】本発明は以上説明したように構成されているので、以下に記載するような効果を奏する。

１．入射光を効率よく利用することができ、画像投影装置の投射画像を明るくすることができる効果がある。

２．パターン状に形成することの困難な偏光分離膜、および偏光回転作用が生じる素子（膜）を平行平板上に全面に設け、パターン状に蒸着することの容易なアルミ全反射膜をストライプ上に形成するという構成上及び製造上簡単な構成で光の方向及び偏光状態を揃えることができる。

３．偏光変換ユニットを小型、軽量とすることができ、これによる画像投影装置を小型化することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施例の構成を示す図である。

【図２】本発明の第１の実施例による画像投影装置の構成を示す図である。

【図３】本発明の第２の実施例の構成を示す図である。

【図４】本発明の第３の実施例の構成を示す図である。

【図５】本発明の第４の実施例の構成を示す図である。

【図６】本発明の第５の実施例の構成を示す図である。

【図７】本発明の第６の実施例の構成を示す図である。

【図８】本発明の第７の実施例の構成を示す図である。

【図９】本発明の第８の実施例の構成を示す図である。

【図１０】本発明の第９の実施例の構成を示す図である。

【図１１】本発明の第１０の実施例の構成を示す図である。

【図１２】本発明の第１１の実施例の構成を示す図である。

【図１３】本発明の第１２の実施例の構成を示す図である。

【図１４】本発明の第１３の実施例の構成を示す図である。

【図１５】本発明の第１３の実施例による画像投影装置

の構成を示す図である。

【図１６】本発明の第１４の実施例の構成を示す図である。

【図１７】従来例の構成を示す図である。

【符号の説明】

101, 901, 1301, 2901, 2303　集光レンズ

101_1～101_3, 901_1～901_3, 1301_1～1301_3, 2901_1～2901_3, 2301_1～2301_3　シリンドリカル微小レンズ

102, 902, 2102　光束

102P, 902P, 2102P　Ｐ偏光

102S, 902S, 2102S　Ｓ偏光

103, 903, 2103　平行平板

104, 304, 504, 604, 704, 804, 904, 1004, 1104, 1304, 2904, 2304　偏光分離膜

105, 505, 605, 705, 805, 905, 1105, 1305, 2905, 2305　アルミ全反射膜

106, 306, 406, 506, 706, 806, 906, 1006, 1306　１／２λ板

250, 2250　光源

251, 252, 258, 259, 2251, 2252, 2258, 2259　ダイクロイックミラー

253, 257, 2253, 2257　全反射ミラー

254, 255, 256, 2254, 2255, 2256　液晶ライトバルブ

260　投射レンズ

409, 510　保持用平行板

411　吸収塗料

606, 1106, 2106, 2306　１／４λ板

708, 808　プリズム板

708_1～708_5, 808_1～808_5, 1307_1～1307_5, 1308_1～1308_3, 2307_1～2307_5, 2308_1～2308_3　微小プリズム

812　遮光部材

1005　全反射膜

1116　吸収部材

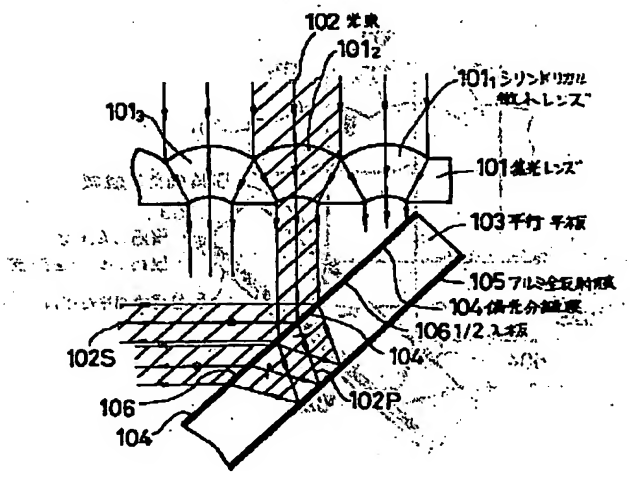
1307, 2307　出射側プリズム板

1308, 2308　入射側プリズム板

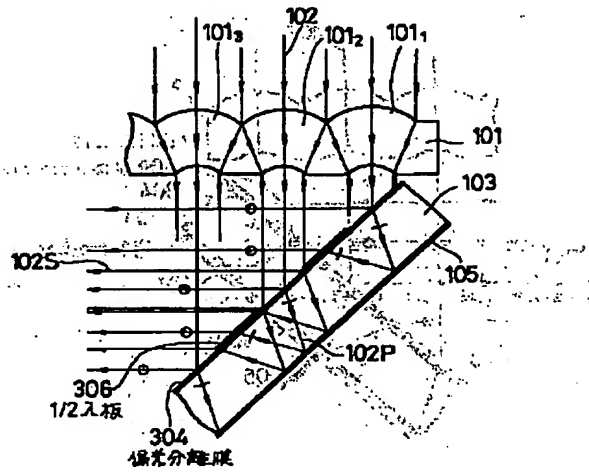
1401_1～1401_3　変換ユニット

2260　投影レンズ

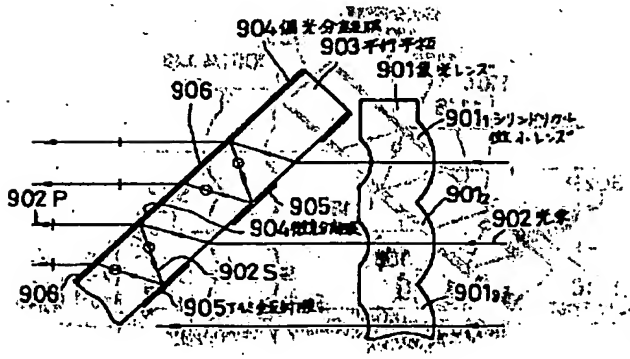
【図１】



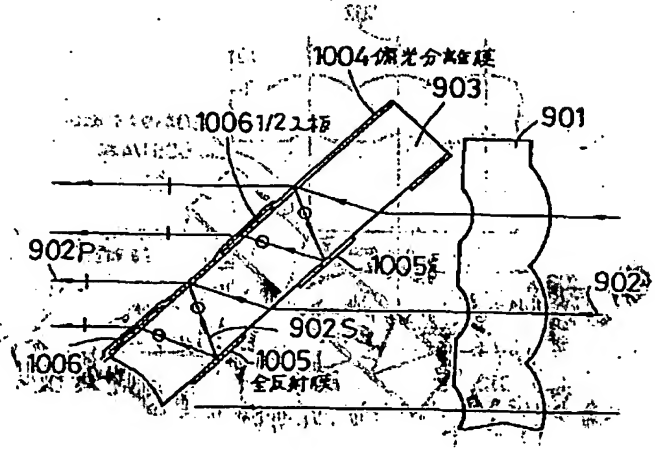
【図３】



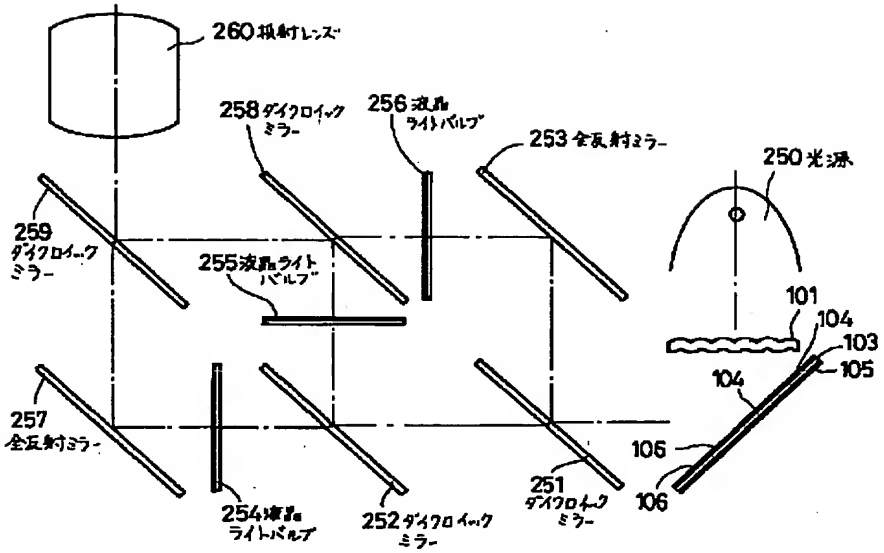
【図９】



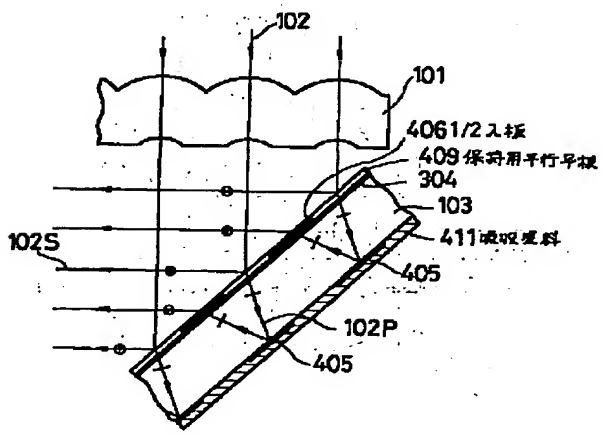
【図１０】



【図２】



【図４】



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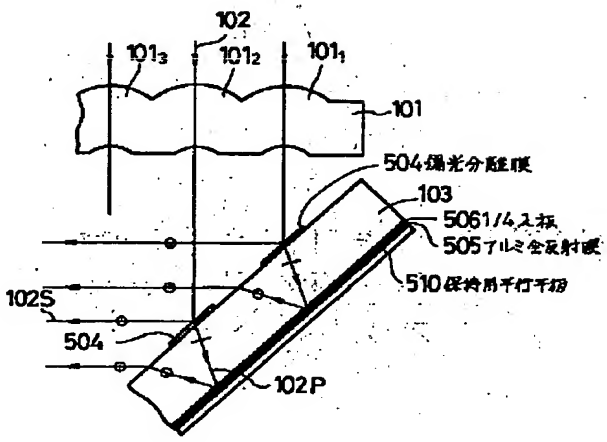
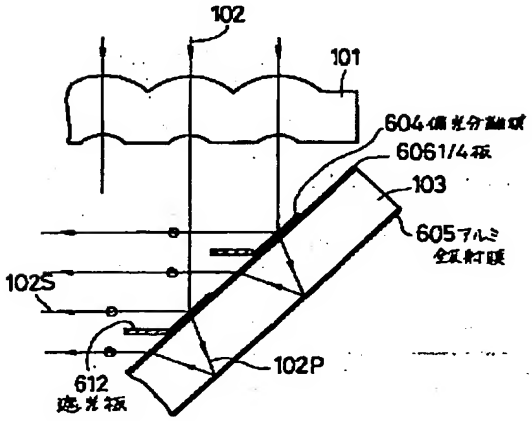
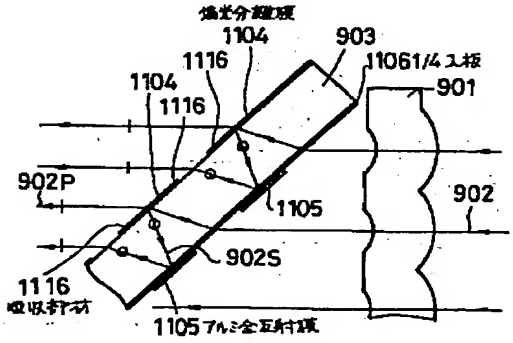


【図６】



【図１１】



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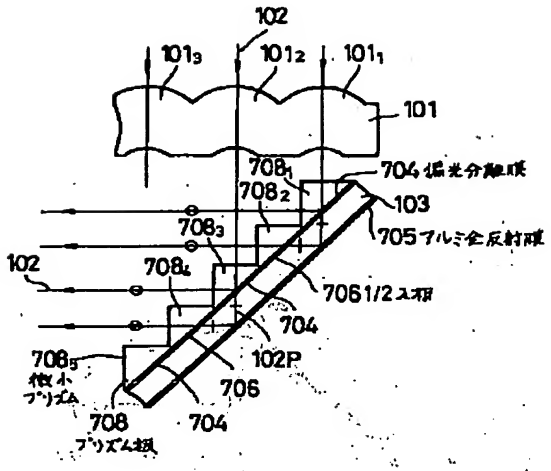

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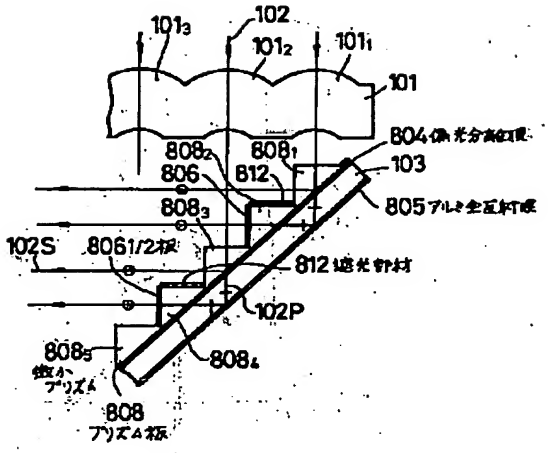
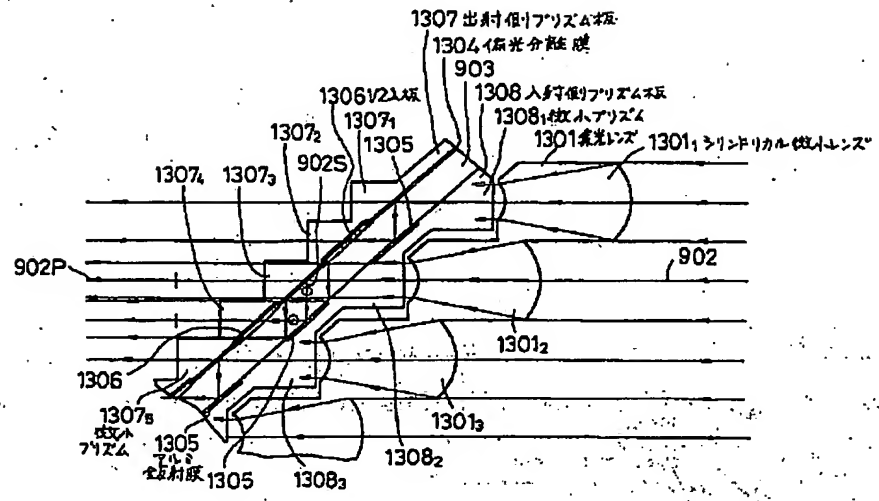


【図１２】



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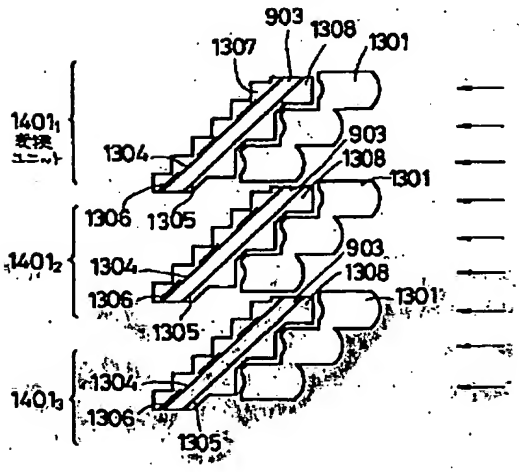
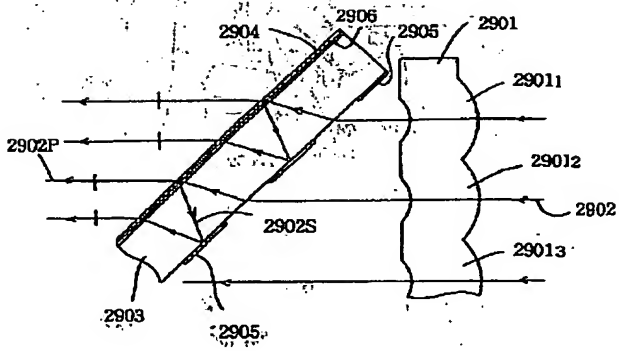
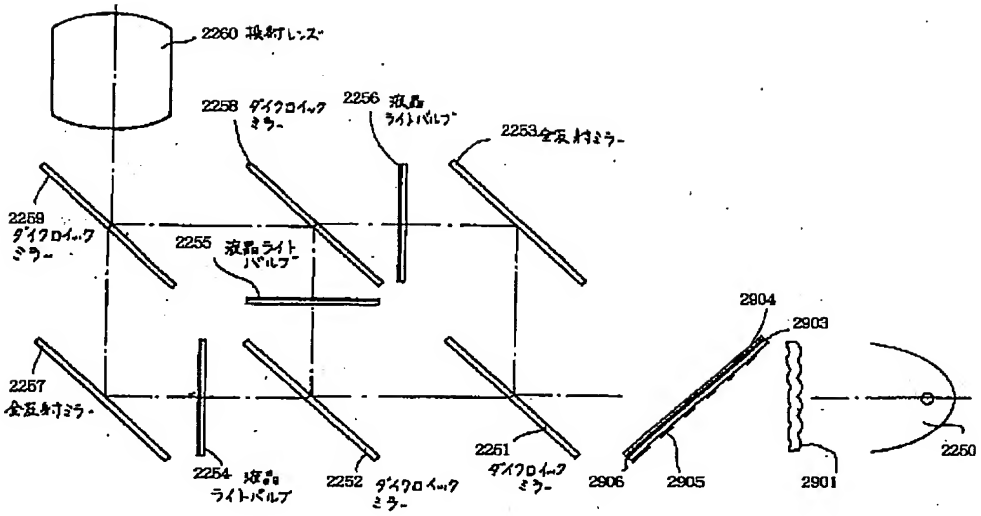


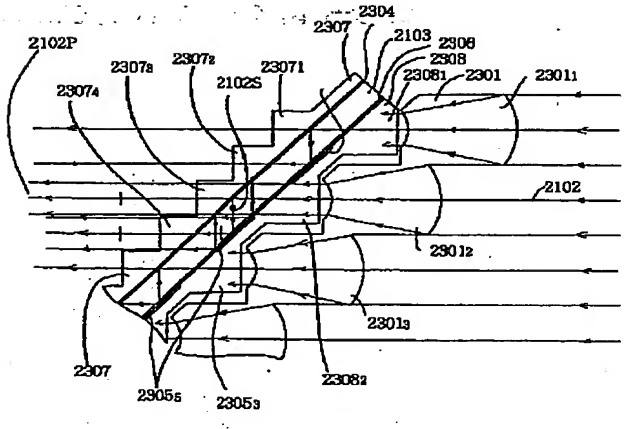
【図１４】



【図１５】


2260 投射レンズ
2258 ダイクロイックミラー
2256 液晶ライトバルブ
2253 全反射ミラー
2259 ダイクロイックミラー
2255 液晶ライトバルブ
2257 全反射ミラー
2254 液晶ライトバルブ
2252 ダイクロイックミラー
2251 ダイクロイックミラー
2904
2903
2906
2905
2901
2250

【図１６】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2307
2304
2103
2308
2308
23081
2301
23011
23078
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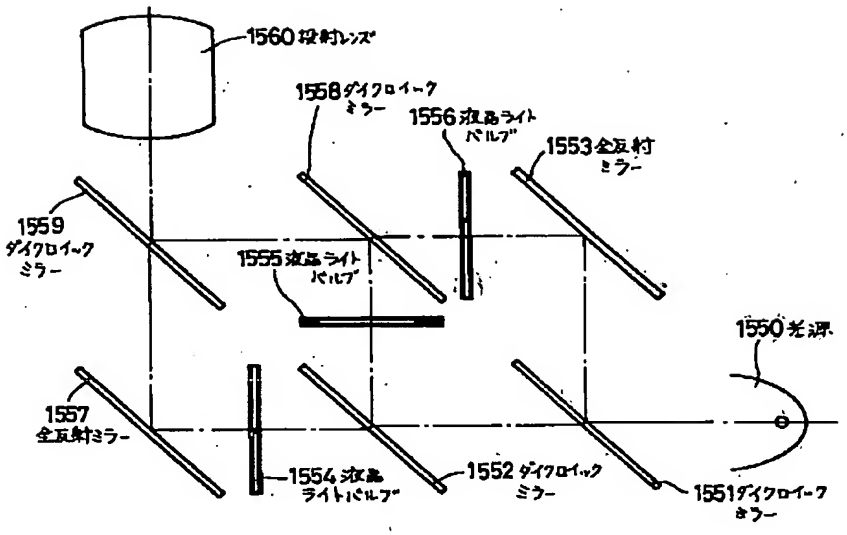
2102S
23074
2102
23012
23013
2307
23082
23056
23053

【図１７】



フロントページの続き

(51) Int. Cl. 5	識別記号	庁内整理番号	F I	技術表示箇所
G 0 3 B 33/12		7316－2K		
H 0 4 N 5/74		A 7205－5C		

【公報種別】特許法第１７条の２の規定による補正の掲載
【部門区分】第６部門第２区分
【発行日】平成１１年（1999）７月２日

【公開番号】特開平５―１０７５０５
【公開日】平成５年（１９９３）４月３０日
【年通号数】公開特許公報５―１０７６
【出願番号】特願平４―８７２１１
【国際特許分類第６版】
G02B 27/28
5/30
G02F 1/13 505
1/1335 510
1/1347
G03B 33/12
H04N 5/74
【ＦＩ】
G02B 27/28 Z
5/30
G02F 1/13 505
1/1335 510
1/1347
G03B 33/12
H04N 5/74 A

【手続補正書】
【提出日】平成１０年４月１３日
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】発明の名称
【補正方法】変更
【補正内容】
【発明の名称】板状偏光素子、該素子を備える偏光変換ユニット、および該ユニットを備える画像装置と画像投影装置
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】透明平行平板の一方の面に、該一方の面又は他方の面側から該平行平板に入射する入射光を反射光及び透過光に分割する偏光分離膜を備え、該反射光及び透過光の一方の光を該透明平行平板の前記他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該反射光及び透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする板状偏光素子。
【請求項２】前記反射光及び透過光の一方の光の偏光面を変化させ他方の光の偏光面と一致させるべく前記透明平行平板の前記一方の面の所定箇所に１／２λ膜が形成されることを特徴とする請求項１の板状偏光素子。
【請求項３】前記反射光及び透過光の一方の光の偏光面を変化させ他方の光の偏光面と一致させるべく前記透明平行平板の前記一方の面の近傍に１／２λ板が配されることを特徴とする請求項１の板状偏光素子。
【請求項４】前記反射光及び透過光の一方の光の偏光面を変化させ他方の光の偏光面と一致させるべく前記透明平行平板の前記一方または他方の面に１／４λ膜が形成されることを特徴とする請求項１の板状偏光素子。
【請求項５】格子状の非偏光光を供給する照明系と、該非偏光光をほぼ稠密な偏光光に変換せしめるべく該照明系の光軸に対して斜設した偏光素子とを備え、該偏光素子が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする偏光変換ユニット。
【請求項６】前記照明系が、多数個の発光素子を並べた光源部とフライアイレンズとを備えることを特徴とする請求項５の偏光変換ユニット。

【請求項７】　前記照明系が、光源からの光を複数個に分割するフライアイレンズを備えることを特徴とする請求項５の偏光変換ユニット。

【請求項８】　前記透明平行平板の他方の面のほぼ全面に反射膜が形成されることを特徴とする請求項５の偏光変換ユニット。

【請求項９】　前記透明平行平板の一方の面のほぼ全面に前記偏光分離膜が形成されることを特徴とする請求項５の偏光変換ユニット。

【請求項１０】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の一方の面で受光し、前記偏光分離膜から前記格子状透過光を前記透明平行平板の他方の面に向けるようにし、前記偏光分離膜上に、前記透明平行平板の他方の面で反射した前記格子状透過光の偏光面を変化させ前記格子状反射光の偏光面と一致させるべく、１／２λ板を格子状に形成することを特徴とする請求項９の偏光変換ユニット。

【請求項１１】　前記透明平行平板の他方の面のほぼ全面に反射膜が形成されることを特徴とする請求項１０の偏光変換ユニット。

【請求項１２】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の一方の面で受光し、前記偏光分離膜から前記格子状透過光を前記透明平行平板の他方の面に向けるようにし、前記格子状透過光を前記透明平行平板の他方の面で反射させると共に前記格子状反射光の偏光面と一致させるべく前記透明平行平板の他方の面のほぼ全面に１／４λ板と反射膜とを形成することを特徴とする請求項５の偏光変換ユニット。

【請求項１３】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の一方の面で受光し、前記偏光分離膜を格子状に形成し前記偏光分離膜から前記格子状透過光を前記透明平行平板の他方の面に向けるようにし、前記透明平行平板の一方の面に前記透明平行平板の他方の面で反射した前記格子状反射光の偏光面を前記格子状透過光の偏光面と一致させるべく、１／２λ膜を前記偏光分離膜と交互に格子状に形成することを特徴とする請求項５の偏光変換ユニット。

【請求項１４】　非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記照明光学系が、前記非偏光光を格子状の光パターンに変換する変換系と、該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光

面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項１５】　非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記非偏光光をＲＧＢの３色の非偏光光に分解する色分解系を有し、該色分解系が該ＲＧＢの３色の非偏光光の各光路に非偏光光を格子状の光パターンに変換する変換系と該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、一方の面に偏光分離膜を設けた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項１６】　非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記非偏光光をＲＧＢの３色の非偏光光に分解する色分解系を有し、該色分解系が該ＲＧＢの内の２色の非偏光光の共通光路と他の一色の非偏光光の光路の夫々に非偏光光を格子状の光パターンに変換する変換系と該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項１７】　透明平行平板の一方の面に、該平行平板の他方の面側から該平行平板に入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設けることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする板状偏光素子。

【請求項１８】　該偏光面回転手段が、該平行平板のいずれか一方の面に設けられた１／４λ膜であることを特

徴とする請求項１７の板状偏光素子。

【請求項１９】　該偏光面回転手段が、旋光性物質であることを特徴とする請求項１７の板状偏光素子。

【請求項２０】　該平行平板を旋光性物質で構成し、前記偏光面回転手段としたことを特徴とする請求項１７の板状偏光素子。

【請求項２１】　ストライプ状の光束を供給する照明系と、該光束をほぼ稠密な偏光光に変換せしめるべく該照明系の光軸に対して斜設した偏光素子とを備え、該偏光素子が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする板状偏光素子ユニット。

【請求項２２】　前記照明系が、多数個の発光素子を並べた光源部とシリンドリカルレンズとを備えることを特徴とする請求項５又は２１の偏光変換ユニット。

【請求項２３】　前記照明系が、光源からの光を複数個に分割するシリンドリカルレンズを備えることを特徴とする請求項５又は２１の偏光変換ユニット。

【請求項２４】　光源と、該光源からの光束を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記照明光学系が、前記光源からの光束をストライプ状に変換する変換系と、該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項２５】　光源と、該光源からの光束を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記光束をＲＧＢの３色の光束に分離する色分解系を有し、該色分解系が該ＲＧＢの３色の光束の各光路に光束をストライプ状の光

パターンに変換する変換系と該ストライプ状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項２６】　光源と、該光源からの光束を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記画像発生器はＲＧＢの各色の画像を発生させる３個の発生器を有し、前記照明光学系が前記光束をＲＧＢの３色の光束に分離する色分解系を有し、該色分解系が該ＲＧＢの内の２色の光束の共通光路と他の一色の光束の光路の夫々に光束をストライプ状の光パターンに変換する変換系と該ストライプ状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子の各々が、透明平行平板の一方の面に、照明系から該透明平行平板の他方の面を透過して入射する入射光を反射光及び透過光に分割する偏光分離膜を略全面に設け、該反射光を該透明平行平板の前記他方の面に断続的な形で設けた反射面で反射して該透過光の光路と略平行な光路に向け、偏光面を回転する偏光面回転手段を該偏光分離膜と該反射面の間に該平行平板の略全面に設ける構成とすることにより該反射光の偏光面を変化させ双方の光の偏光面を一致させることを特徴とする画像投影装置。

【請求項２７】　前記偏光素子が前記格子状非偏光光を前記透明平行平板の前記他方の面で受光し、前記一方の面の偏光分離膜で前記格子状透過光と前記格子状反射光とに分離し、前記格子状反射光を前記透明平行平板の前記他方の面に向けるようにし、前記一方の面上に、前記透明平行平板の他方の面で反射した前記格子状反射光の偏光面を変化させ前記格子状透過光の偏光面と一致させるべく、１／２λ板を格子状に形成することを特徴とする請求項９に記載の偏光変換ユニット。

【請求項２８】　一方の面に偏光分離膜を他方の面に反射膜を形成した透明板を有し、前記一方の面の偏光分離膜により分離された反射光と透過光のうちの透過光を前記他方の面の反射膜で反射することにより前記偏光分離膜に戻し、前記透過光と反射光の少なくとも一方の偏光方向を変化させることにより双方の偏光方向を一致させることを特徴とする偏光素子。

【請求項２９】　前記一方の面上に前記一方の面に斜面

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が重なるように直角プリズム手段を配置し、前記直角プリズム手段の互いに直交する面の一方を通して光を前記透明板に入射させ、前記直角プリズム手段の前記互いに直交する面の他方を通して前記透明板からの光を取り出すことを特徴とする請求項２８の偏光素子。

【請求項３０】　前記一方の面の全面に前記偏光分離膜が形成され、前記他方の面の全面に前記反射膜が形成されていることを特徴とする請求項２８の偏光素子。

【請求項３１】　前記一方の面の全面に前記偏光分離膜が形成され、前記他方の面に間欠的に前記反射膜が形成されていることを特徴とする請求項２８の偏光素子。

【請求項３２】　前記一方の面に間欠的に前記偏光分離膜が形成され、前記他方の面の全面に前記反射膜が形成されていることを特徴とする請求項２８の偏光素子。

【請求項３３】　前記透過光と反射光の一方をλ／２板を一度通すことによりその偏光方向を９０度回転させることによつて前記透過光と前記反射光の偏光方向を一致させることを特徴とする請求項２８の偏光素子。

【請求項３４】　前記λ／２板が前記透明板上に配置されていることを特徴とする請求項３３の偏光素子。

【請求項３５】　前記λ／２板が前記透明板から離れた場所に配置してあることを特徴とする請求項３３の偏光素子。

【請求項３６】　前記透過光と反射光の一方をλ／４板を二度通すことによりその偏光方向を９０度回転させることによつて前記透過光と前記反射光の偏光方向を一致させることを特徴とする請求項２８の偏光素子。

【請求項３７】　前記λ／４板が前記透明板上に形成されていることを特徴とする請求項３６の偏光素子。

【請求項３８】　請求項２８乃至請求項２７のいずれかの偏光素子と、前記偏光素子に複数の光束を入射させるためのレンズアレイとを有することを特徴とする偏光変換ユニット。

【請求項３９】　前記レンズアレイはシリンドリカルレンズアレイまたはフライアイレンズより成ることを特徴とする請求項３８の偏光変換ユニット。

【請求項４０】　請求項３０乃至請求項３７のいずれかの偏光素子または請求項３８と請求項３９のいずれかの偏光変換ユニットと、前記偏光素子または前記偏光変換ユニットからの偏光光を変調して画像光を発生しめる画像発生器とを有することを特徴とする画像装置。

【請求項４１】　請求項３０乃至請求項３７のいずれかの偏光素子または請求項３８と請求項３９のいずれかの偏光変換ユニットと、前記偏光素子または前記偏光変換ユニットからの偏光光を変調して画像光を発生しめる画像発生器と、該画像発生器からの前記画像光を投影する投影系を有することを特徴とする画像投影装置。

【手続補正３】

【補正対象書類名】明細書

【補正対象項目名】００１１

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【補正方法】変更

【補正内容】

【００１１】また、本発明の画像投影装置は、非偏光光を発する光源と、該光源からの非偏光光を偏光光に変換する照明光学系と、該偏光光をビデオ信号に応じて変調することにより画像を発生せしめる画像発生器と、該画像を投影する投影光学系とを備える装置において、前記照明光学系が、前記非偏光光を格子状の光パターンに変換する変換系と、該格子状光パターンをほぼ稠密に偏光光に変換せしめるべく該変換系の光軸に対して斜設した偏光素子とを有し、該偏光素子が、一方の面に偏光分離膜を備えた透明平行平板を有し、該偏光分離膜で生じた格子状反射光と格子状透過光の一方の光を透明平行平板の他方の面に設けた反射面で反射して他方の光の光路とほぼ平行な光路に向け、該格子状反射光と格子状透過光の少なくとも一方の光の偏光面を変化させ双方の光の偏光面を一致させる。本発明の他の形態による偏光素子は、一方の面に偏光分離膜を他方の面に反射膜を形成した透明板を有し、前記一方の面の偏光分離膜により分離された反射光と透過光のうちの透過光を前記他方の面の反射膜で反射することにより前記偏光分離膜に戻し、前記透過光と反射光の少なくとも一方の偏光方向を変化させることにより双方の偏光方向を一致させることを特徴とする。本発明の他の形態による偏光変換ユニットは、上記の偏光素子と、前記偏光素子に複数の光束を入射させるためのレンズアレイとを有する。本発明による画像装置は、上記の偏光素子または偏光変換ユニットと、偏光素子または偏光変換ユニットからの偏光光を変調して画像光を発生しめる画像発生器とを有することを特徴とする。本発明の他の形態による画像投影装置は、上記の偏光素子または偏光変換ユニットと、偏光素子または偏光変換ユニットからの偏光光を変調して画像光を発生しめる画像発生器と、該画像発生器からの前記画像光を投影する投影系を有することを特徴とする。

【手続補正４】

【補正対象書類名】図面

【補正対象項目名】図９

【補正方法】変更

【補正内容】

【図９】